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AIR POLLUTION ASPECTS OF EMISSION SOURCES: PRIMARY ALUMINUM PRODUCTION

A BIBLIOGRAPHY WITH ABSTRACTS

ENVIRONMENTAL PROTECTION AGENCY

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Air Pollution Technical Information Center

ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Water Programs
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June 1973

10

The AP series of reports is published by the Technical Publications Branch of the Information Services Division of the Office of Administration for the Office of Air Quality Planning and Standards, Environmental Protection Agency, to report the results of scientific and engineering studies, and information of general interest in the field of air pollution. Information reported in this series includes coverage of intramural activities and of cooperative studies conducted in conjunction with state and local agencies, research institutes, and industrial organizations. Copies of AP reports are available free of charge to Federal employees, current contractors and grantees, and nonprofit organizations - as supplies permit - from the Air Pollution Technical Information Center, Environmental Protection Agency, Research Triangle Park, North Carolina 27711, or from the Superintendent of Documents.

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AIR POLLUTION ASPECTS OF EMISSION SOURCES: PRIMARY ALUMINUM PRODUCTION– A BIBLIOGRAPHY WITH ABSTRACTS

INTRODUCTION

The Air Pollution Technical Information Center (APTIC) of the Office of Air Quality Planning and Standards prepared, selected, and compiled the abstracts in this bibliography. The abstracts are arranged within the categories listed in the Contents. The abstracted documents are thought to be representative of available literature, and no claim is made to all-inclusiveness.

The subject and author indexes refer to the abstracts by category letter and accession number. The author index lists all authors individually; primary authorship is indicated by an asterisk. Generally, higher accession numbers have been assigned to more recent documents.

Current information on this subject and many others related to air pollution may be found in APTIC's monthly abstract bulletin.*

All of the documents abstracted by APTIC are currently on file at the Air Pollution Technical Information Center, Office of Air Quality Planning and Standards, Environmental Protection Agency, Research Triangle Park, North Carolina 27711. Readers outside of the U.S. Environmental Protection Agency may seek the documents directly from publishers, from authors, or from libraries.

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*Air Pollution Abstracts, Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402. Includes more than 6300 abstracts and subject and author indexes in each issue, and two separate cumulative indexes. Subscription price: $27.00 per year; $6.75 additional for foreign mailing.

A. EMISSION SOURCES

07650

Otlowski, George J., Louis Farkas, George Boyd, and Joseph Hynes

TAKE A DEEP DEADLY BREATH. Middlesex County Dept. of Public Welfare, New Brunswick, N. J., Board of Chosen Freeholders, 35p., ((1967)). (110 refs.)

A proposal was made to construct an aluminum reduction plant in the Raritan Bay area in New Jersey. In an effort to prevent the location of the plant in this area, a report is presented describing the air and water pollution deriving from this industry. The aluminum reduction process is described and sulfur dioxide and fluorides are cited as being major effluents from the process. The health hazards associated with these two pollutants are discussed, and several law suits are mentioned which were brought against various aluminum companies for damages sustained by plants, animals, and humans attributed to emissions from the companies. It is concluded that the Raritan Bay area, which already has an air pollution problem, cannot tolerate the additional burden that the aluminum reduction plant would impose on the atmosphere.

12622

Boehlen, B.

FLUORINE EMISSION AT ALUMINIUM WORKS. Chem. Eng., No 221, CE266-268, Sept. 1968.

The most important of the extraneous substances in the air which arise from alumina reduction are inorganic fluorine compounds, alumina, tar, carbon, sulfur dioxide, and carbon monoxide. The fluorine compounds are particularly important because of their toxicity to livestock and plants. Waste gas purification systems must be of two types. One for purification of the furnace waste gas and the other for purification of air from the premises. The first system for use with the Soderberg furnace consists of a combustion step with cyclone and electrostatic precipitator dust removal, and spray-type scrubbers or filter-plate columns for hydrogen fluoride removal. The system for purification of air from the premises consists of a spray chamber with synthetic fabric lining mounted on the roof. Purification of waste furnace gases from Soderberg furnaces results in a fluorine concentration in the pure gas of less than 10 mg/cu m, while the purification of air from the premises results in a fluorine concentration in the pure gas less than 2 mg/cu m.

13701

Colombini, M., C. Mauri, R. Olivo, and G. Vivoli

OBSERVATIONS ON FLUORINE POLLUTION DUE TO EMISSIONS FROM AN ALUMINUM PLANT IN TRENTINO. Fluoride Quarterly, J. Intern. Soc. Fluoride Res., 2(1):40-48, Jan. 1969. 5 refs.

For many years, women and children complained of skin lesions similar to suffusions in an area of Trentino, near an aluminum plant. These lesions were first observed in the same place about 30 years ago. The symptomatology is related to damage to the vegetation due to emission of fluorine compounds. Since March 1966, three permanent stations were installed in the area in order to collect volatile fluorine compounds. Since February 1967, five deposit gauges were established at progressively increasing distances from the source. Fluorine air pollution has reached values close to and sometimes above 10 micrograms/ cu m of air. Rain water collected for two weeks in the deposit gauges showed decreasing concentrations of fluorine the greater the distance from the source. The highest value of 7.13 mg/L was found in the deposit gauge closest to the factory. In the inhabited area, the fluorine content ranged between 0.14 and 2.55 mg/L. Since May 1967, the degree of fluorine pollution has decreased following installation of modern purification equipment at the plant. (Author summary modified)

17116

Balazova, G., A. Rippel, E. Hluchan, and J. Ambrus

EVALUATION OF FLUOR CONTENT IN LIVING ORGANISM STANDING UNDER THE EFFECT OF FLUOR EXHALATIONS. (Zhodnotenie hladiny fluoru v zivom organizme ovplyvnovanom fluorovymi exhalatmi). Text in Czech. Cesk. Hyg. (Prague), 13(1):12-17, 1968. 21 refs.

Such parameters as air quality, atmospheric fluor content, and content of fluor in dust fall, drinking water, and agricultural products were evaluated in a long-term study carried out in the vicinity of an aluminum plant. At the same time, the fluor content in the teeth, hair, nails, and urine of children living close to the plant was assessed. The mean values of the total fluor content in the air fluctuated from 0.02 to 0.14 mg/F per cu m, and in fallen dust reached up to 7.34 tons of fluor per sq m per yr. The mean fluor content in the drinking water was 0.2 mg/liter. Fluor content in food produced from plants grown in the region fluctuated within 0.5 and 10.0 mg/F/kg, in foods of animal origin within 0.5 and 1.2 mg/F/kg. The fluor content in bones of sparrows, frogs, and rats was two to fourteen times higher than in the controls. The teeth, nails, hairs, and urine of children living in the nearest residential quarter contained an amount of fluor which was twice to three times as large as that of the control children. Examinations in children living in the neighborhood of the plant did not reveal any signs of endemic fluorosis. (Author summary modified)

17471

Knop, Wilhelm

INDUSTIRAL DUSTS AND WASTE GASES. (Industriestauebe und-abgase). Text in German. Wasser Luft Betrieb, 14(2):63-66, Feb. 1970. 22 refs.

The most dangerous and annoying pollutants emitted by various industries are enumerated. Steel mills emit primarily iron oxides and fluorine compounds. Half of the original fluorine input is emitted; the other half goes into the slag. The iron oxide emissions, primarily the small particles below 5 micron, form the brown smoke. The non-ferrous metal fabricating and finishing plants emit metal oxides (cadmium oxide). When inhaled, the latter may be extremely harmful. The TLV (threshold limit value) is 0.1 mg/cu m air. In aluminum production, dust-laden waste gases develop, despite the wet process.

The aluminum oxide dust content in the rotary furnace is 300-400 g/standard cu m. In electrolytic reduction of aluminum oxide, cryolite also dissociates. As a consequence, hydrogen fluoride and dusts of fluorine compounds are found in the waste gas. The TLV for fluorides is 2.5 mg/cu m; for hydrogen fluoride, 2 mg/cu m. In lead plants 3 to 3.5 cu m waste gases per kg sinter develop in the sintering and roasting station. They contain 1.5 to 5% by volume SO2 and up to 15 g/cu m dust. The dust contains lead, zinc, sulfur, and small amounts of other elements. Considerable amounts of metal vapors develop. In the fly dust of the shaft furnaces, cadmium oxide or sulfate, arsenic, zinc, and thallium compounds may be found. In copper smelting plants, the waste gases contain fly dust and SO2. In zinc refining, fly dust (0.1 g/standard cu m) and SO2 are emitted to the waste gas. In ferro-alloy production, dusts of various kinds are carried along in the waste gases. The waste gas quantity of a 10 MW furnace amounts to 70,000-250,000 cu m/h; the dust content, to 0.25-2.5 g/cu m.

23022

Solntsev, S. S.

COMPUTATIONAL METHOD OF DETERMINING FLUORINE BALANCE DURING ALUMINUM ELECTROLYSIS. (Raschetnyy metod opredeleniya balansa ftora pri elektrolize alyuminiya). Text in Russian. Tesvetn. Metal., 40(2):59-62, 1967. 8 refs.

The following quasiempirical formulas for fluorine loss during electrolytic production of aluminum are presented: 1) loss with exhaust gases as a function of cryolite content of the electrolyte and electrolyte temperature; 2) loss with fettlings as a function of service interval; 3) loss in the form of CF4 as a function of the number of anode effects, duration of anode effect, and % yield in terms of current; 4) mechanical loss as a function of the fluoride content of the raw material; and 5) loss with the coal ash. Fluorine loss through exhaust gases is reported for three installations and ranges from 18.97 to 25.63 kg/t. It is estimated that cooling the process by 5 degrees C will reduce fluorine consumption by 0.2 kg/t, while increasing the cryolite ratio by 0.1 will affect approximately a 3 kg/t savings.

23580

Reinhard, H.

FLUORINE DAMAGE IN THE LOWER FRICK VALLEY. (Die Fluorschaden im unteren Frichtal). Schweiz. Arch. Tierheilk., 101(1):1-4, 1959. (Presented at the Swiss Veterinary Society, General Convention, Brunnen, 1959.) Translated from German. Belov and Associates, Denver, Colo., 5p., July 10, 1970.

Even though the only aluminum produced in Germany today is manufactured by an electrolytic method, fluorine emissions are still 500 kg per day. In the area of one plant, the quantity of fluorine sedimented per acre in 1956 amounted to approximately 7 kg at 300 m from the plant, decreased rapidly to 0.9 kg at 700 m, and then decreased slowly with increasing distance. Severe clinica phenomena have been observed on vegetation at quite distant locations and can be attributed only to airborne fluorine. Moreover, feed plants (hay and grass) have been damaged, even when their fluorine levels were below those considered toxic by most authors.

24116

McCabe, Louis C.

ATMOSPHERIC POLLUTION. Ind. Eng. Chem., 47(8):95A-96A, Aug. 1955. 1 ref.

In the electrolytic reduction of alumina, oxygen libertated in the cryolite bath combines with the carbon of the node to produce carbon dioxide. As the CO2 rises through the blanket of alumina covering the electrolytic cells, small amounts of alumina dust and fluorides are entrained. On striking the air the fluorides are hydrolyzed, in part, to hydrogen fluoride gas. Heat generated in the reduction process requires that effective ventilation be maintained to provide satisfactory working conditions in the potrooms, but the high velocities of an induced draft pick up some of the fine dust from the top of the pots. The collecting systems consist basically of a dry type dust separator, an induced draft fan, and a wet scrubber. A typical system of this type uses a dry dynamic precipitator exhauster that is so designed that the dust is separated from the main gas stream within the fan by means of specially shaped blades and a separate outlet in the scroll. The main gas stream, containing some fine dust, is discharged directly to an open tower type scrubber of redwood construction with suitable spray headers. At one large plant, the basic system has been supplemented by an electrostatic precipitator. Fumes generally can be controlled by accurate regulation of the temperature of the bath, the rate of firing, and the amount, method, and type of flux used.

24370

Stuewe, A. Howard

HYDROGEN FLUORIDE: WHERE IT GOES, HOW IT'S MADE, WHY IT'S GROWING. Chem. Eng. News., vol. 36:34-38, 57, Dec. 22, 1958.

Consumption of hydrogen fluoride is expected to reach 215,000 tons in 1963. Grouped under four major categories, the principal market for HF are primary aluminum production, fluorocarbons (refrigerants aerosols), uranium production, and petroleum alkylation (in the production of high octane blending components for gasoline). All HF production is dependent on the reaction of sulfuric acid with fluorspar, domestic reserves of which could become exhausted by the end of the century. Fractional distillation is employed to remove high-boiling impurities (sulfuric acid and water) and lower-boiling impurities (silicon tetrafluoride, carbon dioxide, and sulfur dioxide) from HF.

25135

Rossano, August T., Jr. and Michael J. Pilat

RECENT DEVELOPMENTS IN THE CONTROL OF AIR POLLUTION FROM PRIMARY ALUMINUM SMELTERS IN THE UNITED STATES. Preprint, International Union of Air Pollution Prevention Associations, 19p., 1970. 9 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper EN-16F.)

The alternative processes and equipment employed in the production of aluminum are described. Details of the types and relative magnitudes of pollutants emitted from both the prebaked and continuous anode type of electrolytic refining processes are briefly reviewed and illustrated. Air pollution regulations recently adopted by the Department of Ecology of the State of Washington are presented. These regulations stipulate the maximum permissible concentrations of fluorides in the ambient air surrounding an aluminum smelter and the maximum fluoride content of forage, both expressed on a time average basis. In addition, the regulations restrict the amount of particulate matter emitted. A brief resume of current efforts by industries to meet these new regulations is given. Engineering control measures being developed and tested include wet scrubbers, wet electrostatic precipitators and a new chemisorption technique involving a fluidized bed followed by bag filters. It is concluded that rapidly growing emphasis on the

maintenance and improvement of air quality throughout the United States will serve to stimulate new and better technology for the control of emissions from primary aluminum smelters. (Author abstract)

25178

Teworte, W. M.

SPECIFIC AIR POLLUTION CONTROL ARRANGEMENTS AT NON-FERROUS METAL WORKS. Preprint, International Union of Air Pollution Prevention Associations, 41p., 1970. 20 refs. (Presented at the Internationa Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, Paper EN-28B.)

Information on the cost problem and on the necessity for air pollution control technology in the field of non-ferrous metals production is presented. Their price, high in comparison with that of steel, is an incentive to developing any means of increasing the yield and, thus, to recovering the metals from flue dusts. Therefore, the center of air pollution control arrangements shifts to the side of extracting accompanying elements in the ores, auxiliary materials, and highly volatile compounds. The negative biological effects of a large number of metals require particularly effective arrangements for waste gas purification. More recent specific methods of air pollution control are illustrated by several examples. Fluorine emissions from the flux are fought in aluminum works by means of effective wet purification processes; dry absorption methods are also being tried. Fluorine levels of 0.5-1.5 ppb were detected even in industrial areas where there was no aluminum production at all. Waste gas purification at aluminum re-melting works presents a particularly difficult problem with regard to the extraction of very fine salt fumes. The utilization of the sulfur content in the non-ferrous metal ores is discussed in detail. Here, the solution to the economic problem of marketing a sulfuric acid, aptly called 'acide fatal' by Belgian smelting works, is as important as the solution to the process-technical problem. The latter was dealt with very successfully by means of the development of a double-contact process with intermediate absorption for roasting gases poor in sulfur dioxide. The final gases contain less than 0.5% of the SO2 charge. More and more processes favorable to air hygiene are being used by zinc metallurgy. Methods of recovery that cannot be controlled by waste gas technology, will be discarded. General and particular information is given on the cost problem of air pollution control. Frequently, the wrong conclusions are drawn from the fact that only 0.2% of the value of industrial production are required for direct steps, with secondary injurious effects, amounting to 1-2%, being prevented in this manner. Production at some works is hard hit by specific costs of 1-5% of the proceeds from sales. (Author abstract)

26441

Oglesby, Sabert, Jr. and Grady B. Nichols

A MANUAL OF ELECTROSTATIC PRECIPITATOR TECHNOLOGY. PART II -- APPLICATION AREAS. Southern Research Inst., Birmingham, Ala., NAPCA Contract CPA 22-69-73, 875p., Aug. 25, 1970. 118 refs. NTIS: PB 196381

The application of electrostatic precipitators is reviewed for the electric utility industry, the pulp and paper industry, the iron and steel industry, the rock products industry, the chemical industry, in cleaning municipal incinerator dusts, for the petroleum industry, and in the nonferrous metals industry. Particular emphasis is placed on the dust and gaseous emissions of the processes discussed. This is followed by a tabulation of input and design parameters for precipitators operating on various types of dust control problems and an analysis of critical design parameters and test results. Cost data are also presented. The electrolytic reduction of aluminum, the production of copper, primary lead, and zinc reduction are discussed in the area of the nonferrous metals industry. In the petroleum industry, catalytic cracking and detarring are indicated as application areas. Refuse properties are discussed, as well as types of incinerators. Sulfuric acid production, the production of elemental phosphorus, phosphoric acid, and carbon black, warrant the use of precipitators in the chemical industry. In the rock products industry, the manufacture of Portland cement and the gypsum industry present problems. Coke ovens, sinter plants, blast furnaces, open hearth furnaces, basic oxygen converters, electric arc furnaces, scarfing machines, and iron cupolas are areas of application in the iron and steel industry. In the pulp and paper industry, precipitators are indicated for the recovery of boiler particulate emissions and sulfate process flue gases. Fly ash precipitators are needed in the electric utility industry.

30296

Teworte, W.

THE USE OF FLUORINE-BEARING MATERIALS IN THE GERMAN FEDERAL REPUBLIC. (Einsatz von fluorhaltigen Materialien in der BRD). Text in German. VDI (Ver. Deut. Ingr.) Ber., no. 164:11-18, 1971. 13 refs.

Before World War II, Germany was the world s largest supplier of fluorine. In 1938, it produced 30% or 140,000 tons out of a total world production of 462,000 tons. Since then, the situation has changed completely. In 1969, the world consumption amounted to about 3.6 million tons, out of which Mexico as the largest producer provided one million tons; Germany s participation was only 90,000 tons which placed it eighth after Mexico. This latter production was practically used up completely by the domestic industry; in addition, some 160,000 tons were imported to cover the overall demand of 250,000 tons. Of the world s consumption of fluorine in 1969, 45% were used for steel manufacturing, 15% for aluminum, 33% for producing chemicals, and 7% for glass and ceramics. The chemical industry requires fluorite, CaF2, primarily for producing hydrofluoric acid, HF. Two tons of CaF2 are needed for producing one ton of HF. Hydrofluoric acid in turn is used as an intermediate product for the manufacture of numerous inorganic and organic fluorine compounds. Among the inorganic compounds are aluminum fluorides, used as flux material in the production of primary aluminum. The organic fluorine compounds include the aliphatic chlorine-fluorine-hydrocarbons, such as freon, which are used as spraying and cooling substances. Other important fluorine- bearing products are synthetic materials, such as teflon. Direct applications for fluorspar can be found in the manufacture of steel, of welding electrodes, enamel, glass wool, and other industrial products.

30447

Nelson, Kenneth W.

NONFERROUS METALLURGICAL OPERATIONS. In: Air Pollution. Arthur C. Stern (ed.), Vol. 3, 2nd ed., New York, Academic Press, 1968, Chapt. 37, p. 171-190. 16 refs.

While sulfur dioxide from the smelting of copper, lead, and zinc has been the principal pollutant of interest in nonferrous metallurgy, gaseous and particulate fluorides from aluminum smelting are also of concern. Fluoride problems first came to attention because of adverse effects on grazing animals rather than effects on vegetation, as with SO2. The mining, milling, and concentrating of copper, lead, and zinc are discussed, as well as their refining and smelting, emissions, and controls. The mining and ore treatment of aluminum is considered, its

electrolysis, and emissions and controls. Copper, lead, zinc, and aluminum produced from scrap are also discussed. The production of nonferrous alloys is noted.

31935

Nakamura, Keigo

ON AIR POLLUTION CAUSED BY HYDROGEN FLUORIDE. (Fukka suiso ni yoru taiki osen ni tsuite). Text in Japanese. Kogai To Taisaku (J. Pollution Control), 6(4):50-58, July 1971. 9 refs.

When the atmosphere contains as little as 10 ppb of hydrogen fluoride, crops can be damaged, because the HF is accumulated in the leaves. Teeth and bones are also affected when cattle eat feed containing 30-50 ppm HF over an extended period of time. Fluoride emissions are issued from plants which process ores containing fluoride compounds. Steel mills in Japan are using about four kg fluorspar/ton steel. Various types of scrubbers are utilized to recover fluoride from aluminum smelter and phosphorus fertilizer exhaust gases. Collectors are then used to trap fluoride and sulfuric acid mists.

32483

Commoner, Barry, Michael Corr, and Paul J. Stamler

THE CAUSES OF POLLUTION. Environment, 13(3):2-19, April 1971. 24 refs.

Growth in population, per capita consumption, and environmental impact per unit of production are examined as possible factors contributing to the problem of air pollution. United States data for the years 1946-1948 are examined. The change in pollution level for that time increased the range from 200 to 1000%. Population growth, however, was only 43%. The Gross National Product (GNP) increased about 126% and the GNP per capita increased about 59%. The general production classes that increased sharply in per capita consumption included synthetic organic chemicals and the products made from them; wood pulp and paper products; total production of energy; total horsepower of prime movers, especially petroleum driven vehicles; cement; aluminum; mercury used for chlorine production; and petroleum and its products. The increase was in the range of 100 to 1000%, which concurred with changes in the pollution level. The possible contributions of these activities to air pollution are examined and the use of mercury in the chemical process industries is chosen as an informative example.

34484

Mark, W. van der

AIR POLLUTION DUE TO FLUORIDES. (Luchtverontreiniging door fluor). Text in Dutch. Chem. Tech. (Amsterdam), 26(15):413-417, 1971. 30 refs.

The destructive effects of fluorides on plants, animals, and humans are described. Sources of fluorides such as aluminum industries and phosphate factories are discussed. The measurement and sampling of fluoride contents are explained. Two methods of measurement are described: measurement of total fluoride content in air and collection of gaseous fluorides or fluoride containing materials. The advantages and disadvantages of each method are discussed. Electrochemical, spectrophotometric, and activation analyses are mentioned. The separation of fluorides by a microdiffusion method is briefly described.

34916

Bureau of Census, Washington, D. C.

PRODUCT CLASSES - VALUE SHIPPED BY ALL MANUFACTURING ESTABLISHMENTS: 1947, 1954, 1958, 1963 TO 1967. In: Smelting and Refining of Nonferrous Metals and Alloys. p. 33C-29, 1970.

Quantities shipped by all manufacturing establishments of copper, lead, zinc, aluminum, primary nonferrous metals, and secondary nonferrous metals are tabulated for 1947, 1954, 1958, and 1963 to 1967. Both smelter and refined materials are included.

34921

Bureau of Census, Washington, D. C.

MATERIALS CONSUMED, BY KIND: 1967 AND 1963. In: Smelting and Refining of Nonferrous Metals and Alloys. p. 33C-31, 1970.

The quantity consumed in the smelting and refining of nonferrous metals and alloys of aluminum ingot, aluminum and aluminum-base alloy scrap, copper, lead, zinc, and tin is listed for 1963 and 1967. Delivered costs are also indicated.

35381

ALUMINUM. In: Bureau of Mines Mineral Yearbook. Washington, D. C., Government Printing office, 1969, 22p. 14 refs.

The aluminum industry is reviewed with respect to domestic production, costs, recycling of aluminum scrap, consumption, foreign trade, and technology. Improvements in aluminum potline efficiency, the use of electric charges in the processes, producing alumina from aluminiferous raw materials, with no waste products emitted into the atmosphere, and strengthening the superficial characteristics of aluminum are examined.

35592

National Materials Advisory Board, Washington, D. C., Panel on Fluorspar

TRENDS IN THE USAGE OF FLUORSPAR. National Academy of Sciences - National Academy of Engineering, Washington, D. C., Pub. NMAB-269, 54p., Dec. 1970. 21 refs.0 NTIS: PB 198339

Three major segments of American industry (steel, aluminum, and fluorocarbon producers) use approximately 93% of the fluorspar consumed in the United States and will probably continue to require large and assured supplies well beyond the next decade. The fluorspar demand of the aluminum industry may decrease because of fluorine recovered from waste products and phosphate production. However, the overall fluorspar demand should contiue to grow as the result of increasing requirements for the product of steel and fluorcarbons. The total fluorspar demand was 1.24 million tons in 1968 and is projected to increase to 1.8 million in 1975 and to 2.2 million in 1980. Due to environmental concern, secondary sources of fluroine are beginning to be exploited in greater volume. The principal source is a by-rooduct from the production of phosphates. (Author abstract modified)

39462

Midwest Research Inst., Kansas City, Mo.

PARTICULATE POLLUTANT SYSTEM STUDY. VOLUME III - HANDBOOK OF EMISSION PROPERTIES. Air Pollution Control Office Contract CPA 22-69-104, MRI Proj. 3326-C, 626p., May 1, 1971. 302 refs.

Details of the methodology employed to obtain data concerning the kind and number of stationary particulate sources, the chemical and physical characteristics of both the particulates and carrier gas emitted by specific sources, and the status of current control practices, are presented. Emission factors and rates, chemical and physical properties of effluents, and control practices and equipment are given for stationary combustion processes (power generation and furnaces); mineral processing; agricultural operations (field burning, grain elevators, cotton gins); iron and steel manufacturing; cement manufacturing; forest products industry (sawmills, pulp industry); primary nonferrous metallurgy (copper, lead, zinc, and aluminum smelting and refining); clay products; fertilizer manufacturing; asphalt; ferroalloy manufacturing; iron foundries; secondary nonferrous metals industry; coal preparation; carbon black manufacturing; petroleum refining; acid manufacture (sulfuric acid and phosphoric acid); and incineration. The control equipment includes cyclones, wet scrubbers, electrostatic precipitators, fabric filters, mist eliminators, and afterburners. Effluents include dusts, particulates, fly ash, sulfur oxides, hydrocarbons, and other noxious gases. Costs for control equipment purchase and operation are given. This handbook constitutes a reference source for available information on the distinguishing features of the various particulate pollution sources and should be of value to air pollution regulatory agencies, control equipment manufacturers, and industrial concerns.

40182

Takahashi, Noboru

ENVIRONMENTAL POLLUTION BY METAL INDUSTRIES. (Kinzoku sangyo ni yoru kankyo osen). Text in Japanese. Kagaku (Science), 41(10):551-556, Oct. 1971.

Iron works produce mineral powder and coke powder as particulates and sulfur dioxide. More than 50% of the SO2 is from the sintering process. By an approximate calculation, a plant with a capacity of annual production of 1000 tons crude steel produces 7,000,000 cu m SO2 every year. The SO2 gas from an iron works also contains extremely poisonous arsenic trioxide. The same plant discharges about 2400 tons of waste water yearly. Casting industries generate approximately 6000 tons of particulates yearly, of which about 50% are silicon dioxide. In zinc production industries, cadmium is generated since its contamination in zinc mineral is approximately 0.25%. It is discharged as dust into air and as waste in waste water. In aluminum refining, fluorides are generated, and for a production of 1 ton aluminum about 20 to 30 kg of fluorine are also produced as fluorides. Cyanides are largely used in metal gilding and thermal treatment, approximately 50% for the former and 30% for the latter. These cyanides, accompanied with cadmium, have been the major pollutants in the rivers in large cities.

42676

Ministerium fuer Arbeits, Gesundheit und Soziales des Landes Nordrheim-Westfalen, Duesseldorf (West Germany)

NONFERROUS METALLURGY. (NE-Metallerzeugung). Text in German. In: Reine Luft fuer morgen. Utopie oder Wirklichkeit. Moehnesee- Wamel, West Germany, K. ron Saint George, 1972, p. 60-65.

The present situation and future trends in the output and emissions in the nonferrous metallurgy of North Rhine-Westphalia are described. The aluminum industriy, which accounts for more than 50% of the total output of West Germany, will experience rapid growth. The basic pollutants are gaseous fluorine compounds (0.8-1.5 kg/t), aluminum- and fluorine-bearing dust (9-20 kg/t), sulfur dioxide (3-15 kg/t), and carbon monoxide. Aluminum remelting is expected to increase 100% by 1980. Chloride aerosols, metal oxides, and gaseous fluorine compounds are the chief pollutants. Dust separation at a rate of 15% was applied to rotary furnaces in 1970. Dust emissions will decrease from 1320 tons in 1970 to 680 tons in 1980 by lowering the dust concentration to 150 mg/N cu m and 100 mg/N cu m for rotary furnaces and thermal chips treatment facilities, respectively. Gaseous fluorine emissions, 90 tons in 1970, will be reduced to 50 tons in 1980 by applying wet-type gas cleaning. Sulfur dioxide emissions from lead manufacturing will be reduced 90% due to waste-gas desulfurization. The efficiency of SO2 separation at sulfuric acid production facilities is 98%. Lead and zinc emissions, amounting to 350 and 180 tons in 1970, will decrease to 50 tons each in 1975. Sulfur dioxide emissions from copper manufacturing, for which a 2% yearly rate of growth is predicted, will rise from 900 tons in 1970 to 1100 tons in 1980, the waste-gas SO2 concentration being 0.2 g/N cu m. Hydrochloric acid emissions, now 500 tons, will decrease by 50%. While total dust emission will be reduced from 600 to 300 tons, no further reduction in lead, zinc, and copper emissions is possible. The dust emissions from copper alloy manufacturing will be 10% of the 1970 level by 1980, as an upper limit of 50 mg/N cu m will be set in 1973. Sulfur dioxide emissions from zinc manufacturing, for which electrolytic processes are increasingly used, will decrease from 1800 tons in 1970 to about 1500 tons in 1980. The imposition of a maximum allowable dust emission of 50 mg/N cu m in 1973 will result in zinc and lead emissions, now 160 and 40 tons, decreasing to 80 and 20 tons, respectively, despite a growth rate of 40%.

42731

Safonov, V. N., V. A. Limanskii, V. P. Klyushkin, E. G. Levkov, N. G. Bulgakova, G. I. Il in-kaya, N. A. Borisenko, and A. S. Levkova

THE PHYSICAL PROPERTIES AND CHEMICAL COMPOSITION OF DUST FORMED DURING THE PRODUCTION OF ALUMINUM AND SILUMIN. Tsvetn. Metal., 44(4):42-44, 1971. 12 refs. Translated from Russian. Trans-Chem, Inc., Knoxville, Tenn., 6p.

The physical properties and chemical composition of dust have a significant effect on the basic operating character of dust removal devices, and these determine the expediency of using a specific type of dust removal system. Hence, methods for the determination of physical properties and chemical composition of dusts are reviewed. The dispersion of dust particles by particle size at four different plant locations was determined by methods of three dust extractors and an impactor (a multistage jet precipitator). Both methods measure the dispersion of dust particles directly in a gas conduit; the latter, however, gives more reliable results. For measuring the specific electrical resistance of electrolyzer and silumin dust, a device was used in which a dust layer is formed between two filtering surfaces under conditions found in a gas conduit. An advantage of this method for forming the dust layer lies in the fact that it is not necessary to measure the thickness of the dust layer, since it is always constant and equal to the distance between the discs. Regarding chemical composition, fluorine components are of special interest since they are harmful to the attendant personnel as well as being valuable components. Fluorine which is tied up in the form of complex fluorides was determined by a gravimetric method on lead fluorochloride and also by a mercurous and mercuric method using diphenyl carbazone as an indicator. Results are also given for the fluorine determination by a thorium method using alizarin red S as an indicator. Aluminum, calcium, and magnesium were

determined by complexometric methods. Silicon was determined photometrically by the dark blue silicomolybdenum complex with elimination of the interference of fluoride ion by boric acid. The basic method for determining the resinous material requires the extraction of polynuclear aromatics with non-fluorescing benzene and then measuring the fluorescence of the extracts. Iron was determined by an orthophenanthroline method after the fluorine was extracted by fusing with potassium pyrosulfate.

43271

Environmental Protection Agency, Research Triangle Park, N. C., Office of Air Programs

METALLURGICAL INDUSTRY. In: Compilation of Air Pollutant Emission Factors. OAP Pub-AP-42, p. 7-1 to 7-22, Feb. 1972. 61 refs. NTIS: PB 209559

Primary and secondary metal industries are discussed. The primary industries, producing metals from ore, reviewed are: non-ferrous operations of aluminum ore reduction, copper smelters, lead smelters, zinc smelters, iron and steel mills, ferroalloy production, and metallurgical coke manufacture. Large quantities of sulfur oxides and particulates are emitted by these industries. The secondary metallurgical industries, which recover metal from scrap and salvage and produce alloys from ingot, include aluminum operations, brass and bronze ingots, gray iron foundries, lead smelting, magnesium smelting, steel foundries, and zinc processing. The major air contaminants from these operations are particulates in the forms of metallic fumes, smoke, and dust. Control methods used are: cyclones, electrostatic precipitators, filters, and baghouses.

44490

Environmental Engineering, Inc., Gainesville, Fla.

BACKGROUND INFORMATION FOR ESTABLISHMENT OF NATIONAL STANDARDS OF PERFORMANCE FOR NEW SOURCES: PRIMARY ALUMINUM INDUSTRY. Environmental Protection Agency, Div. of Abatement Contract CPA-70-142, Task Order 2, 55p., March 15, 1971. 25 refs.

Aluminum processes are reviewed, and emissions from primary aluminum smelters are listed. Sulfur oxides are generally considered to be an insignificant air pollution problem in the smelting process. Nitrogen oxides are also insignificant, except as developed in ancillary activities. No information is available on the emission of alumina dust. Fluorides are the emissions of greatest concern. Total fluoride emission increases with temperature. Total fluoride emissions from the best run plants are reported at 2.3 to 6 lb/t of aluminum with 16 to 48% in the gaseous form. Particulates from these same sources range from 9 to 50 lb/t of aluminum. Some gaseous hydrogen fluoride is evolved. Reduced sulfur compounds have not been found. Odors are not thought to present a problem. The recommended standard for gaseous and particulate fluorides is 2.4 lb/t Al; total particulates, 5 lb/t Al; and visible emissions, Ringelmann No. 1.

44605

Less, L. N. and J. Waddington

THE CHARACTERISATION OF ALUMINUM REDUCTION CELL FUME. Preprint, American Inst. of Mining, Metallurgical, and Petroleum Engineers (AIME), New York, N. Y., 10p., 1971. (Presented at the American Institute of Mining, Metallurgical, and Petroleum Engineers, Annual Meeting, New York, Feb. 26-March 4, 1971.)

The nature of the fume emitted by aluminum reduction cells with prebaked anodes was investigated. The gaseous and particulate contributions under different conditions of cell operation were assessed, and the constitution and particle size distribution of the dust determined by chemical and X-ray examination, together with optical and scanning electron microscopy. Approximately 50% of the fluorine emission is in the form of hydrogen fluoride. The particulate material exhibits a double size distribution with one fraction consisting substantially of dust greater than 5 micron diameter and the other of fine material considerably less than 1 micron diameter. The principal components of the coarse fraction are alumina, carbon, and frozen droplets of cryolite; the fine fraction appears to consist mainly of condensed fluoride vapor approximating in composition to chiolite (5NaF.3A1F3). This fine particulate material accounts for about 35% of the total fluorine emission from the cells. Some parallel observations on the character of the fume evolved from vertical stub Soderberg cells are also discussed. The principal differences are that approximately 90% of the fluorine is present as HF, and that the dust, and parucularly the alumina content, is lower than from a prebake cell. (Author abstract)

45420

Lelyuk, V. P., Ye. G. Levkov, and L. A. Fesenko

PHASE CONVERSION OF TARRY PRODUCTS OCCURRING IN GASES EMITTED BY ALUMINUM ELECTROLYSIS WORKSHOPS. (Fazovyye prevrashcheniya smolistykh veshchestv v otkhodyashchikh gazakh tsekhov elektroliza alyuminiya). Text in Russian. Tsvetn. Metal., no. 4:41-43, 1972. 4 refs.

Phase conversions of aluminum electrolyzer-generated tarry products were investigated by determining solid-to-gaseous phase ratios at four different points of the waste gas line (electrolyzer outlet after the burner, before the inlet of the collector pipe, as well as before and after the electrostatic dust precipitator). The solid-to-gaseous phase ratios obtained for the first two sampling points at high temperature gradient were equal, increased ratios for the last two points due to the prevalence of condensation over solid phase precipitation were observed. A sharp decrease in the phase ratios at the electrostatic filter outlet was found. The tarry products continued to condense within the electrostatic filter, depending on the temperature gradient. The degree of condensation was a direct function of the temperature gradient near the electrolyzer with burner cut off. Gaseous products were burned by the burner in much higher proportions than solid phase, with corresponding reductions to 1/45 vs. 1/6 of the original amount. Considerable increase in the precipitation in the waste gas pipe with burner cut off was observed. The bulk of the unburned gaseous products has a condensation interval of 70-200 C, which means that electrostatic filters should be operated at 60 C temperature. The residual dust after the electrostatic filter was mainly in a fraction of 0-5 micron; at this point, the content of tarry substances was highest at 27.65%.

45858

Lukey, Michael E. and M. Dean High

EXHAUST GAS CONVERSION FACTORS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 16p., 1972. (Presented at the Air Pollution Control Assiciation, Annual Meeting, 65th, Miami, Fla., June 18-20, 1972, Paper 72-88.)

The exhaust gas parameters from 76 combustion and industrial sources are given including fuel combustion processes, refuse incineration, mineral industries, chemical industries, metallurgical processes, pulp mills, and refineries. The main objective of the study was to define a relationship of the exhaust gases being emitted, to the process weights. Each of the 76 industrial

source factors includes a process description, the potential air contaminants, operating time, abatement equipment, an input-output relationship, and the exhaust gas parameters: gas flow rate, gas temperature, gas velocity, and stack height. An attempt was made to relate the exhaust gas parameters to an input or output quantity. Thus by knowing the production rate of a plant, one can use these exhaust gas source factors and pollutant emission factors to obtain engineering estimates of specific plant emission and its community inpact through modeling. Sources include coal, oil, natural gas, and wood combustion, incineration; burners; chemical processes such as ammonia, carbon black, chlorine, hydrofluoric acid, paint, phosphoric acid, plastics, ink, soap, sulfuric acid, synthetic fibers, and rubber production; food and agricultural processes; primary metallurgy; steel, lead, zinc, and aluminum production including sintering, blast furnaces, electric furnaces, and open hearth furnaces; petroleum refining, pulp mills; dry cleaning; and surface coating.

47061

Dobbs, C. G.

FLUORINE, THE FAVOURED POLLUTANT. Protectio Vitae, no. 3:105-109, 1972. 37 refs.

The annual average fluorine content in rainwater of 0.16 mg/l was raised to a range varying from 0.28 mg/l to 10 mg/l in the neighborhood of industries using fluorine. Test plants with a normal F-ion content of 7-15 mg/kg dry weight could have had as much as 500 to 1850 mg/kg in the polluted areas. Also, a direct correlation between the F-ion level in the rainwater and in the test plants was found. A much higher F-ion content in food plants such as lettuce, leeks, parsley, and various fruits grown in industrial areas was found. The hazards of pollution are of two main types - intensive and extensive. The intensive type usually causes acute and visible damage which result, eventually, in some sort of action to eliminate it. Unfortunately, the action often consists in the transformation of intensive into extensive pollution, as with the high stack policy. All it did was to spread the pollutant over a wider area where its effects will be more difficult or impossible to distinguish from those of other factors. A case in point is the large aluminum plant near Holyhead in North Wales. At the Public Enquiry in 1968 the estimated total emission was 928 lbs/day of fluoride. By 1970 this amount had risen to 1436 lbs. The stack was raised from 300 ft to 400 ft and provided with an additional rise from an internal hot pipe from the anode plant.

B. CONTROL METHODS

01687

S.C. Rothman

ENGINEERING CONTROL OF INDUSTRIAL AIR POLLUTION: STATE OF THE ART, 1966. Heating, Piping, Air Conditioning Mar. 1966. 141-8 pp. (Presented before the First World Air Pollution Congress, Buenos Aires, Argentina, Nov. 1965.)

Problems encountered by the engineer are illustrated through analysis of air pollution control in the aluminum production industry. Prebaked pots and Soderburg pots and their fluoride emissions are considered.

05090

A. J. Teller

CONTROL OF GASEOUS FLUORIDE EMISSIONS. Chem. Eng. Progr. 63, (3) 75-9, Mar. 1967.

Emission factors for fertilizer manufacture and for aluminum manufacture are presented. The primary design problems of recovery systems are stated. The pressure drop requirement, transfer unit requirements, effluents from phosphoric acid production, some scrubbing systems, design criteria, and hybrid systems are considered. efluents from phosphoric acid production, some scrubbing systems, design criteria, and hybrid systems are considered.

05601

R. R. Ott and R. E. Hatchard

CONTROL OF FLUORIDE EMISSIONS AT HARVEY ALUMINUM, INC. - SODERBERG PROCESS ALUMINUM REDUCTION MILL. J. Air Pollution Control Assoc 13 (9) 437-43, Sept. 1963. (Presented at the 29th Annual Meeting, Northwest Pollution Control Association, Salen, Ore., Oct. 24-27, 1962.)

A 300 Soderberg, vertical-stud type aluminum mill, located just north of the municipal boundaries of The Dalles, Ore., began production in July 1958. Multiclone type dust collectors and scrubber towers were provided as part of the initial mill installation. Tests have shown that the fluoride removal efficiencies of the scrubbers are 95% or higher if satisfactory maintenance and operation are provided. In response to complaints filed by a private party in 1959 and by agricultural interests in The Dalles area in the spring of 1960, the Sanitary Authority intensified the area, mill, complaint, and air sample surveys and evaluations. Horticultural damage from fluorides has been shown to occur in certian foliage and fruit grown in The Dalles area. Research investigations by the Oregon State University's Agricultural Experiment Station are continuing and include a proposed project for the evaluation of any effect of fluorides upon sweet cherry crop production. The emissions from individual reduction cells, which by-pass the vacuum collection ducts to the control system, have been a suspected source of fluoride discharges that were contributing to the horticultural damage. These emissions originate at the cells during several operational steps including inadequate maintenance of the cell. Roff monitor fluoride sample data obtained in 1961 led to a pilot project including an evaluation of fluoride removal efficiencies. The Authority has granted conditional approval for the roof monitor control system subject to its operation at a maximum fluoride removal efficiency. The five cell building roof monitor systems were completed in September 1962. These controls include an arrangement of spray nozzles for wetting fluoride particulates, aerosols, and gases prior to impingement or absorption on poly-vinyl plastic screens - built into the cell building roof monitors. The final evaluation of the effectiveness of this fluoride removal system will depend upon its over-all reduction in the occurrence of horticultural damage in The Dalles area. (Authors' summary)

06587

R. C. Specht and R. R. Calaceto

GASEOUS FLUORIDE EMISSIONS FROM STATIONARY SOURCES. Chem. Eng. Progr. 63, (5) 78-84, May 1967.

Methods of controlling the emission of fluorides from the brick and tile, steel, aluminum, and phosphate fertilizer industries are examined. The brick and tile industry receives brief treatment and a concluding statement mentions that a venturi type scrubber was used in bottle manufacture with 92% efficiency. In the steel industry, the emission of fluorides from sintering plants exceeds those from open hearth furnaces and different control measures are required. The addition of 6% weight of ground limestone to the sintering mix reduced fluoride emission by nearly one half. The final treatment consists of the means for supplying and injecting pulverized limestone and the final dust separation equipment. Reduction of fluorides is estimated at 96%. The basic difference between the treating systems of the sintering and open hearth processes is the pressure under which they operate and the material used as a reactant; CA (OH) 2 is used in the open hearth process. Among the methods discussed in regard to the aluminum industry are the wetting by sprays of the hot gases escaping through roof monitors, the use of a sieve-plate gas absorber column, and a floating bed type of scrubber which overcomes the tar-fouling problem and is reported to remove 95% of fluorides. Fluoride control is achieved with cyclones and packed towers. The effects of fluorides on vegetation, cattle, and man are briefly discussed including the effects of inhalation of HF at various concentrations.

07815

Borenstein, Murray

AIR POLLUTION CONTROL IN NON-FERROUS METALLURGICAL INDSUTRY. (THE USE OF WET SCRUBBERS). Ind. Heating, 34(10):1866, 1868, 1870, Oct. 1967.

Fumes emitted from the processes involved in the non-ferrous metallurgical indsutry consist of extremely fine particulate matter of submicron size. These fumes result from the heating operations, from the use of fluxes and from reduction processes, all of which produce highly corrosive emissions. Types of controls include wet-scrubbers and bag filters. A typical Airetron installation for capturing fluoride emissions during electrolysis of aluminum ore is described; it employs 20 cyclonic air scrubbers operating at a low pressure drop of 3 in.

w.g. which neutralizes gaseous fluorides at the rate of 90,000 cfm at 200-250 deg F. for a total of 1.8 million cfm of gas purified. Recovery of the metal is accomplished, in this case, by permitting it to settle out of the resulting liquid and recharging it into the furnace. In this system all solids are recovered through the recycling. In the wet-scrubbers, the fumes become highly corrosive when wetted and linings such as rubber or polyester-fiberglass must be used in their construction. Bag filters provide high cleaning efficiency and operate at relatively low power costs. However, the replacement of the filter bags themselves is a high maintenance item. The non-ferrous industry thus requires some of the most sophisticated air pollution control equipment for production of an essentially low-cost product.

07925

Beighton, J.

THE SPECIAL INDUSTRIAL PROCESSES. Roy. Soc. Health J. (London). 87(4):215-218, July-Aug. 1967. 2 refs. (London)

The air pollution problems of a group of industries which produce: sulfuric acid, nitric acid, petroleum and petrochemicals, iron and steel, copper, aluminum, gas, ceramics and electric power are reviewed. The basic technical approach is to avoid the formation of the emission by design of the process, then to require the treatment of any unavoidable emission, and finally to require adequate dispersal of any residual amount which has to be discharged. The legislation is designed to compromise between safeguarding of public health and amenities and providing for a realistic acceptance with adequate control of special processes. Although the loss of gases in the manufacture of sulfuric acid is limited to 2% of the sulfur burned, the loss from a contact acid plant with a 500-ton-per-day capacity may be considerable so that chimney heights as high as 450 ft may be required. Acid mist from contact plants burning sulfur is a special problem as it is difficult to control and its occurrence is unpredictable. There are two nitric acid plants in Britain equipped with catalytic tail-gas reduction units which should solve the problem of brown nitrous fume emission to the air. The use of special flares is required to control H2S and mercaptans emitted by oil refineries. In the steel industry the development of the Fuel-Oxygen-Scrap process is regarded as an alternative to the electric arc furnace. It is claimed that melting and refining can be carried out without exceeding a fume level of 0.05 grains per cu ft.

10372

Erga, Olav, Kare Ryan and Adolf K. Syrdal

GAS CLEANING PRACTICES AT MOSJOEN ALUMINUM WORKS. ((Gassrenseanlegg ved Mosjoen Aluminiumverk.)) Text in Norwegian. Tek. Ukeblad (Oslo), 114(12):232-237, March 30, 1967. 3 refs.

Mosjoen Aluminum Works' solution to cleaning the oven gases given off by the electrolytic aluminum production processes is outlined, with emphasis on the fluoride compounds which have adverse effects on the environment. Mosjoen has developed the construction of a practical model (by Erga et. al.) which uses selective absorption of fluorine from the gases from aluminum reduction cells with vertical spike Soderberg anodes. Economic and efficiency statistics are given to justify the method in the Norwegian industrial environment. Diagrams showing the components of the equipment are given illustrating the fluoride recovery technique.

11686

H.R. Hickey

CONTROLLING ALUMINUM EFFLUENT REDUCTION. Air Eng., 10(10):20- 22, Oct. 1968.

In the manufacture of aluminum from alumina by electrolytic reduction, fluorides and hydrocarbons are the principal effluents. Fluoride removal from collected gases poses no problem with conventional scrubbing equipment. However, the hydrocarbons condense as submicron tar particles which plug multiple cyclones and baghouses thereby limiting the options available in selecting control devices. Research to overcome the hydrocarbon problem is needed.

13676

Erga, Olav, Kare Ryan, and Adolf Syrdal

RECOVERY AND UTILIZATION OF FLUORINE PRODUCTS FROM ALUMINUM ELECTROLYSIS WASTE GASES. In: Abwasser, Abgas Schwebstofftechni Dechema-Monograph., 59(1045-1069), Frankfurt am Main, Deutsche Gesellschaft fur chemisches Apparatewesen E.V., 1968, p. 191-198. 4 refs.

Gases released during aluminum electrolysis contain HF, SO2, and CO2 which are all absorbed with the alkaline solution used in present recovery procedures. A method and apparatus are presented for the selective recovery of HF for hydrofluoric acid production. A sieve plate scrubber utilizing water as the absorption agent was developed by Elektrokemisk. The device features a tower consisting of sieve plates and funnels and a circulation pump for gas distribution. One unit is sufficient for HF recovery. Pilot plant tests showed more than 99% of the HF was absorbed, producing an acid of 3% HF by weight. The co-absorption of SO2 was negligible. Use of the tower for cryolite production also results in an economically feasible by-product.

16446

Vypov, A. I. and G. N. Makarets

PROTECTION OF THE AIR AND WATER BASINS AT NOVOKUZNETSK. (Zashchita vozdushnogo i vodnogo basseynov v novokuznetske). Text in Russian. In: Sanitation Measures Against Air and Water Pollution in the Planning of Cities. (Ozdorovleniye vozdushnogo i vodnogo basseynov gorodov). Government Committee on Civil Building and Architecture (ed.), Lecture series no. 2, Kiev, Budivel 'nik, 1968, p.37-38.

An overall examination of the pollution problems of Novokuznetsk was made in 1965-1966 by the Deputy Commission on Natural Conservation and the Presidium of the Novokuznetsk Branch of the Association for Natural Conservation. Dust emission from the Kuznetsk cement plant was 260 tons per day in 1962; it was reduced to 50 tons per day by the end of 1966, and the installation of electrofilters at two roasting furnaces in 1968 reduced emission to 10 tons per day. Measures were also taken to reduce emission from the aluminum and iron-smelting plants. Efforts at pollution control in this city are regarded as successful and similar measures are recommended for other Soviet cities.

16537

Fujiwara, Masahiro

AIR POLLUTION CONTROL IN ALUMINIUM WORKS UNDER ALKALI AND WORKS REGULATION ACTS IN ENGLAND AND WALES. (Eikoku no arukariho ni motozuku aruminyumu kojo niyoru taikiosen boshi gyosei). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 3(3):13-15, March 15, 1967.

Air-pollution control in England is based on the Alkali and Works Regulation Acts and the Clean Air Act. The country is divided into seven Alkali Inspectors' Districts administered by 25 inspectors who maintain close contact with local health and smoke inspectors. The annual reports compiled by the inspectors form the basis of the Manual Reports submitted to the Ministry of Housing and Local Government. These reports contain the air pollution plans and policies currently in practice. The contents of the Manual Report of 1960, 1964, and 1965 are summarized. Though England does not have a primary aluminum refining industry, it has aluminum manufacturing industries which mainly treat aluminum scraps. Air pollution problems due to aluminum manufacturing, and countermeasures, are discussed in the 1960 Manual Report. A number of plants found venturi scrubbers unsatisfactory for reducing smoke emissions. Better results were obtained by rinsing the aluminum scrap and discharging smoke from taller stacks. The 1964 Manual Report shows that the problem of an oily smoke was partly solved by afterburners and that of fumes solved by employing hearth furnaces (flat type) which do not require flux. The reports emphasize the cooperation between legal authorities and industry. This approach to practical control measures has implications for countries which are trying to control air pollution by legal means alone.

16962

Kielback, A. W.

THE DEVELOPMENT OF FLOATING-BED SCRUBBERS. Chem. Eng. Progr. Symp. Ser., 57(35):51-54, 1961. 6 refs.

Aluminum is produced by the electrolysis of alumina dissolved in an electrolyte consisting of cryolite and other fluoride salts. The reduction process is carried out in cells called pots. During operation of the pots, fluoride-bearing fume, gaseous hydrogen fluoride, carbon oxides, sulfur dioxide, and particulate matter such as alumina, carbon, and tar are released from the pots. Containment of these materials has been a problem in wet scrubbers with grids or other fixed packing and impingement surfaces because the surfaces requiring the most wash receive the least. Cleaning problems are severe when the gas contains either tar particles or tar-coared solids. Floating-bed scrubbers eliminate these problems by virtue of a self-cleaning device. Gas is passed upward through a bed of light spheres, increasing liquid hold-up and sphere buoyancy. As a result, the spheres are free for rotational movement and for movement in relation to each other. High gas turbulence is set up in the bed when the upward flowing gas contacts the descending liquor. The effect is intimate mixing of gas and liquor to promote a hard scrubbing action. About 95% removal of fluorides at pressure drops of 3 1/2 to 4 in. water gauge was obtained in pilot studies of scrubbers containing polyethylene spheres. Other proven application of the floating-bed scrubber are treatment of aluminum-fluoride converter tail gas to remove silicon tetrafluoride and treatment of magnesium chlorinator tail gas to remove silicon tetrachloride.

17463

Hoeke, Bert and Horst Arnim Wittbold

WASH SOLUTION FOR PURIFYING FLUORINE-CONTAINING WASTE GASES IN ALUMINIUM INDUSTRY. (Waschloesung zur Reinigung fluorhaltiger Abgase in der Aluminiumindustrie). Text in German. Wasser Luft Betrieb, 14(1):24-29, Jan. 1970. 7 refs.

The separation of fluorine compounds and dust from waste gases of aluminum plants was studied in the laboratory. A suitable scrubbing liquid was determined for the waste gas; the developing compounds had to be soluble to avoid crystallization in the dust collectors and on pipes. Four test series were carried out with a rotating wet collector. The fluorine compounds could be removed to a large extent with an alkaline scrubbing liquid. A slight dependence of the degree of efficiency on the pH value of the scrubbing liquid was observed. At pH 8 to 12, the gaseous fluorine compounds could be removed to a residual concentration of less than 0.5 mg/standard cu m. The salt content of the circulating scrubbing liquid increased in the course of the experiments to a maximum of 64 g salt/liter water. The fluoride content of the scrubbing water reached 7 g F/l. Maintenance of a pH of more than 10.5 and a salt content of less than 70 g/l helped to prevent any incrustations. This necessitated periodic replenishment of the spent scrubbing liquid by fresh water. The spent liquid was treated with aluminum salts to precipitate the fluoride in the form of kryolith. The dry precipitant contained between 48 and 51% F which could be reused. The sludge collecting in the circulating scrubbing liquid had a settling time of 2 hours. Flocculants did not reduce this settling time. The water content of the sludge was 98%.

18002

Tomany, James P.

A SYSTEM FOR CONTROL OF ALUMINUM CHLORIDE FUMES. J. Air Pollution Control Assoc., 19(6):420-423, June 1969.

During primary aluminum processing the molten aluminum is periodically fluxed with chlorine to separate impurities from the metal. The gaseous effluent from the chlorination process contains submicron particulates and gaseous vapors which produce a dense, white plume. The plume is acidic with hydrogen chloride and chlorine vapors, which cause a variety of corrosion problems. Since the stack discharge temperature can range as low as 200 F -- and aluminum chloride sublimates at about 360 F, blockage of ductwork can also occur. For effective removal of both the particulates and chloride gases in the effluent, a sodium hydroxide solution is recommended. Since, such a scrubbing liquor produces a flocculent precipitate, a nonplugging type of scrubber is required. The solution UOP advanced was a 'mobile packing' type of scrubber, utilizing a bed of polypropylene spheres in random, turbulent motion. The motion of the packing prevents plugging. The paper describes the design for such a system, describing the optimum use of ductwork, scrubber placement, gas saturation, and recirculation equipment. Instrumentation requirements, both minimum and optimum are discussed. A case study is detailed in which gases containing 5 gr/sef of particulates and 4 gr/sef of hydrochloric acid and chlorine vapors were passed through such a system. The cleaned effluent contained only 0.009 gr/sef of particulates and 0.002 gr/sef of vapors. (Author's Abstract)

18255

Tomany, J. P.

METHOD FOR REMOVING CHLORINE AND ENTRAINED ALUMINUM CHLORIDE PARTICLES FROM A WASTE GAS STREAM. (Universal Oil Products Co., Des Plaines, Ill.) U. S. Pat. 3,445,182. 5p., May 20, 1969. 2 refs. (Appl. Feb. 15, 1965, 6 claims.)

A method is described for scrubbing and removing Cl and entrained A1C13 particles in a gaseous effluent stream from an aluminum purification process. The waste gas is brought into contact with a liquid spray stream to effect an initial agglomeration and removal of a portion of entrained particles as well as humidification of the effluent stream by direct contact with the liquid. The humidified effluent is passed upward through a contacting zone having at least one stage of low

density contact elements. The upward movement of the gas causes the contact material to form a loose, mobile, floating bed in this stage which is retained by a perforated barrier. An alkaline scrubbing liquid is introduced into the top of the stage to continuously wet the floating contact particles and to provide countercurrent contacting. The scrubbed gases are exited from the top of the contact zone and the spent liquid from the bottom. A typical scrubbing liquid for the process is a 5% NaOH solution.

19210

Matsuda, Norikazu

ABATEMENT OF AIR POLLUTION CAUSED BY FLUORIDE. (Fukkasuiso oyobi kakushu fukkabutsu niyoru taikiosen no taisaku). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 6(7):509-514, July 15, 1970.

Sources of fluoride pollutants include aluminum refining and phosphate fertilizer, brick, glass, glass-fiber, steel, and cement manufacturing. Fluorides emissions from an aluminum refinery and a phosphate fertilizer plant, both subject to large numbers of damage claims, are shown in a block diagram. Examples of fluoride pollution by the Showa Denko plants in Fukushima and Chiba and Sumitomo Chemicals in Ehime are presented. Regulations applicable to pollutant sources in Osaka and Fukushima Prefectures are noted. A common method of processing fluorine compounds is the use of caustic soda. Fluorine becomes sodium fluoride, which is subsequently converted to calcium fluoride by lime. In aluminum refineries, the recovery rate of fluorine by the method is over 99%. Exhaust gas, however, shows a recovery rate of only 60-70%, even in factories equipped with a recovery device. If the density at the source is lowered to several ppm, the use of chimneys around 200-m high will reduce the ground concentration to .1 ppb. At present, the recovery of fluorides is accomplished by wet methods, which give rise to mists such as hydrofluoric acid. The efficient processing of the mist is a future problem. Since the demand for aluminum is predicted to be 2,000,000 tons in 1975, an increase in aluminum refineries is expected. In the process of construction, future refineries must be thoroughly evaluated for fluoride pollution.

19487

Knapp, Lester L. and Clayton C. Cook

TREATMENT OF GASES EVOLVED IN THE PRODUCTION OF ALUMINUM. (Aluminum Co. of America, Pittsburgh, Pa.) U. S. Pat. 3,503,184. 3p., March 3, 1970. 5 refs. (Appl. March 7, 1968, 5 claims).

A process for removing hydrogen fluoride and finely divided solids from gas evolved in the electrolytic production of aluminum entails passing the gas stream upward for 0.25 to 1.5 sec through a 2- to 12-in. bed of finely divided alumina particles. The hydrogen fluoride is sorbed by the alumina particles and the finely divided solids are entrapped in the fluidized bed, which contains 50 to 150 pounds of alumina per pound of hydrogen fluoride. The alumina particles containing hydrogen fluoride are removed from the bed and fed to the fluoride baths of electrolytic cells. The gas stream leaving the bed is passed through bag filters on the surfaces of which any remaining finely divided solids and alumina particles small enough to be carried upward are deposited. The average residence time of alumina particles in the bed is 2 to 14 hrs.

20248

Public Health Service, Cincinnati, Ohio, National Air Pollution Control Administration

A STATUS REPORT: PROCESS CONTROL ENGINEERING; R & D FOR AIR POLLUTION CONTROL. 37p., Nov. 1969.

The various phases of the work of the Process Control Engineering Division of the National Air Pollution Control Administration are described as of late 1969. These include sulfur oxides control (dry and wet limestone processes, coal cleaning, and new processes such as those employing molten alkali carbonates). industrial process control (nonferrous smelting, iron and steel, sulfuric acid, papermaking, graphic arts, iron foundries, aluminum smelting, etc.), combustion emissions control (e.g., fluidized-bed combustion, nitrogen oxides), applied equipment research (wet scrubbers, fabric filters, electrostatic precipitators, incinerator control), supporting measurements (detection, spectroscopy, dust- and gas-sampling analysis, holographic determinations, continuous monitors, etc.), and advisory and supporting services. A special report is also given on the alkalized alumina process for control of SO2. A list of 110 specific research projects and 11 services is given. More than eleven million dollars was budgeted for the Process Control Engineering programs in 1969. The 1970 budget is expected to be more limited, necessitating an emphasis on sustaining rather than new programs.

20366

Jueng, Carl F.

METHOD AND APPARATUS FOR EXHAUSTING GASES FROM INDUSTRIAL BUILDINGS. (Robertson (H. H.) Co., Pittsburgh, Pa.) U. S. Pat. 3,492,789. 4p., Feb. 3, 1970. 2 refs. (Appl. May 16, 1968, 10 claims).

A ventilation procedure for factories producing aluminum or similar compounds is described that produces a single exhaust stream of relatively low velocity exhaust gases, thereby permitting all of the surface area of filter mats in the wet scrubbing zone to be utilized. The invention also concerns the placement of exhaust fans to prevent their corrosion by hydrofluoric acid escaping from the wet scrubber. The exhaust gas is divided into two separate streams, each stream separately pressurized by fans and impinging against one another in a mixing zone prior to emergence into the wet scrubbing zone as a single stream. Since the fans are placed at fixed intervals along the length of the mixing zone, which extends continuously above the heat-generating apparatus, the pressurized streams expand horizontally and vertically. This reduces their velocity to a low value prior to introduction into the wet scrubbing zone. Contact between the fans and any corrosive fluids escaping from the wet scrubbing zone is avoided by positioning the fans upstream of the scrubbing zone. Apparatus for carrying out the method is provided.

21324

Kato, Yujiro

PLANS AND OPERATIONAL EXAMPLES ON FILTER TYPE DUST COLLECTOR SYSTEM AT VARIOUS INDUSTRIES (VI). THE ROLE OF BAG FILTERS IN THE METALWORKING INDUSTRY. (Gyoshubetsu ni miru rokashiki shujin sochi no keikaku to unten jisshi rei (VI). Kinzoku kogyo ni okeru baggu firuta). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 4(10):663-668, Oct. 15, 1968.

The operational conditions of bag filters used for emission control in the metalworking industry are illustrated by examples. In the zinc refining industry, bag filters are used at various points. The baghouse for the independent electric power

plant which is provided to allow the exhausted material to cool down is one example. Another is the baghouse for controlling emissions from a smelting furnace exhaust. The applications of bag filters to the aluminum industry is illustrated by the baghouse used to control emissions from an alumina coveying process. In a powdered lead manufacturing plant, a complete dust collector has to be provided since the lead dust is extremely toxic and cannot be allowed to escape into the atmosphere. Complete hooding is also necessary. In the nonferrous metal working industry, emissions are commonly worth recovering. High efficient dust collectors are adequate for this purpose. In the iron and steel industry, the collected material from the exhaust is generally of little value, but dust collectors are necessary for air pollution control. Their use is typified by baghouses equipped for controlling emissions from electric-arc steelmaking furnaces and from electric furnaces for ferro-alloy manufacture. In the metal processing industry, bag filters are also used for controlling emissions from various processes. An example is the baghouse equipped for controlling emissions from the finishing process of iron casting.

22566

Donoso, Julius J.

DEVELOPMENT OF A PRACTICAL AND ECONOMICAL PROCESS FOR REMOVING THE ALUMINUM CHLORIDE SMOKE NUISANCE DURING THE CHLORINATION OF ALUMINUM ALLOYS. Smoke Prevention Assoc. of America, New York, Proc. Smoke Prevent. Assoc. Am. 40th, 1947, p. 39-42.

Chlorination of molten aluminum alloys for the removal of elements such as magnesium results in the formation of aluminum chloride vapor which, when exhausted to the atmosphere and hydrolyzed, creates dense and voluminous smoke. The smoke nuisance is not abated by tall stacks. However, a steam injection process for treating the vapor has been developed and successfully tested in a pilot plant. By introducing the steam into the furnace effluent gas, the aluminum chloride vapor is converted to stable aluminum hydroxide, which decomposes at 600 F into aluminum oxide and water. The solid and stable aluminum oxide particles are readily precipitated in a Cottrell treater. The corrosive hyperchloric acid formed by the reaction of aluminum chloride and water vapor is recovered by passing furnace gases through a scrubbing tower and fiberglass filter before exhausting them to the atmosphere. At the pilot plant, the effluent visible gas has consisted of condensed steam that is rapidly absorbed in the atmosphere.

22853

Cochran, C. N., W. C. Sleppy, and W. B. Frank

FUMES IN ALUMINUM SMELTING: CHEMISTRY OF EVOLUTION AND RECOVERY. J. Metals, 22(9):54-57, Sept. 1970. 7 refs. (Presented at the TMS-AIME Annual Meeting, 1970.)

Traces of gaseous and particulate fluoride must be removed from the effluent of aluminum smelting cells. Fluoride emission, both particulate and gaseous, increases with increase of temperature and decrease of bath ratio and aluminum oxide content. Hydrogen fluoride from reaction of moisture with aluminum fluoride- containing bath species increases with increasing partial pressure of H2O. The water vapor originates from the atmosphere, from constitutional water or water adsorbed on the aluminum oxide or from burning of hydrogen or hydrocarbons from the anodes. The particulate is removed by electrostatic precipitators, mechanical precipitators, scrubbers or bag filters. Gas scrubbers or adsorption on aluminum oxide are used for removal of HF. Adsorbing HF on aluminum oxide as a chemisorbed monomolecular layer permits recovery of the sorbed fluoride and the direct return of the fluoride to the pot. The chemisorbed fluoride is initially amorphous but forms aluminum fluoride upon heating. Physically adsorbed HF (in contrast to the chemisorbed layer) is re-evolved as HF on adding the recovery product to the pot. Thus, the fume removal process should be limited to the chemisorption reaction. Efficiency of HF recovery with aluminum oxide increases as fume concentration increases and the ratio of recovery product to pot feed increases. (Author abstract)

22983

Lyons, A. L.

ALUMINA KILN DUST COLLECTION. Minerals Process., 11(8):13-15, Aug. 1970.

Dust collection systems for hot abrasive materials such as those discharged by an alumina kiln require special design considerations. The system described not only curtails alumina dust losses from belt transfer points but permits the recovery of dust-laden air from fluidized-bed coolers. Ore, which enters the cooler at 600-650 F, is fluidized and cooled to 300 by passing it over water-filled coils. A multiple cyclone and an electrostatic precipitator are employed in series to collect the calcined dust, which is too abrasive for bag filters. Deterioration of duct work and elbows is minimized by seamless pipe and welding fittings. Other components of the collecting system are reducers with specially designed branch entries and a butterfly damper.

23370

Boehlen, B.

FLUORINE EMISSION AT ALUMINIUM WORKS. Chem. Engr. (London), 46(7):266-268, Sept. 1968.

The electrolysis of fused alumina, with cryolite as the fluxing agent and electrolyte, gives rise to waste gases with a fluorine content. The method by which the electrolysis furnaces operate requires two separate waste-gas purification systems, one for interception and conveyance of waste furnace gases to a purification plant, and one for cleaning fluorine-contaminated air used for ventilation of furnace room premises. The purification processes for both systems are described briefly, and the problems are reviewed. Because of the large quantities of waste air involved, considerable costs are incurred to provide the power required for ventilation, the large quantities of scrubbing water, and the pumps to convey the water; the presence of corrosive hydrogen fluoride creates added difficulties. The possibility of replacing cryolite by electrolytes which do not contain fluorine is recommended for future research.

24743

Damon, W. A.

ABATEMENT OF AIR POLLUTION IN THE CHEMICAL INDUSTRY. Chem. Ind. (London), vol. 41:1266-1270, Oct. 8, 1955. 11 refs. (Presented at the London Section of the Society of Chemical Industry Symposium on the Prevention of Atmospheric and Water Pollution in the Chemical Industry, London (England). (April 4-5, 1955.)

The special problems of air pollution arising from chemical processes are largely dealt with under the provisions of the Alkali etc. Works Registration Act, 1906, and the Alkali, etc., Works Regulation (Scotland) Act, 1951, as extended by subsequent legislation. Those processes that are considered to be the greatest potential contributors to air pollution are defined

and not permitted to operate in the absence of control equipment for noxious or offensive gases. In connection with certain processes, e.g., sulfur acid manufacture, statutory limits of acidity are laid down; but, in general, reliance is placed on the use of the best practicable means. Suitable methods of treatment are given for noxious constituents of chemical reagents, odorous permanent gases from petroleum refining processes, sulfur oxides from fuel combustion, and waste gases from metallurgical processes, including electrolysis of alumina. It is emphasized that the control of these sources often requires changes in the processes themselves.

26317

Gelperin, N. I., V. M. Tarasov, and A. Yu. Valdberg

REMOVAL OF HYDROGEN FLUORIDE FROM GASEOUS MIXTURES WITH THE AID OF FLUIDIZED BED SCRUBBERS WITH SPHERICAL PACKING. (Ochistka gazov ot ftoristogo vodoroda v scrubberakh s psevdoozhizhennoy sharovoy nasadkoy). Text in Russian. Khim. Prom. (Moscow), no. 10:62-64, 1970. 4 refs.

A fluidized-bed scrubber designed to remove hydrogen fluoride from exhaust gases generated during electrolytic production of aluminum is described. A 40-50 g/l sodium carbonate solution was used at an irrigation density of 2.2-31 cu m/sq m/hr, a linear gas flow rate of 2.2-5.6 m/sec, and an initial HF concentrations of 15-150 mg/cu m. The static column packing height was variable from 35 to 175 mm. Operating characteristics in terms of the unit transfer number, defined as the logarithm of the ratio of HF concentrations before and after scrubbing, are presented.

28320

FILTER PROGRAM. (Filterprogramm). Text in German. Wasser Luft Betrieb, 15(1):36-39, Jan. 1971.

Various types of filters for cleaning waste gases are described. Gases escaping from electrolytic cells used in the melting of aluminum are cleaned by passing them through an aluminum oxide layer where the gaseous fluorides are absorbed. Next the gases are passed through envelope-type cloth filters which retain the aluminum oxide particles. The aluminum oxide is returned to the reduction cells, the fluorides to the melting zone. The process is a dry one which has the advantage of not converting an air-pollution problem to a water pollution problem. A new wet dust collector consists of a high-capacity precipitator, 1200 mm high and 3000 mm long packed with synthetic material. Collection efficiency is about 99.4%. Water consumption is to 0.1 to 0.2 liters/cu m waste air. A filter for radioactive, pathogenic, and toxic substances consists of a rim board with O- grooves and a plastic sack that allows contamination-free replacement of the air filter. In a metallurgical plant, the dust-laden waste gases are conducted through water-cooled pipes to a scrubber, where the gases are washed with water. The scrubbing water circulates in a closed system to avoid water pollution.

30519

Ball, D. F. and P. R. Dawson

AIR POLLUTION FROM ALUMINIUM SMELTERS. Chem Process Eng., 52(6): 49-54, June 1971. 16 refs.

Control methods for a number of the pollutants emitted during aluminum production are discussed. The production process is briefly described. The main pollutants which arise in electrolysis are alumina, tar-pitch distillation products, inorganic fluorine, compounds including hydrogen fluoride, sulfur dioxide, hydrogen sulfide, carbonyl sulfide, carbon disulfide, silicon tetrafluoride, and water vapor. The gases from the furnace contain fluorine compounds, carbon monoxide, carbon dust and tar, and hydrocarbons. These gases are sent to an afterburner, a cyclone, and an electrostatic precipitator. The gases may still contain HF and SO2, which can be removed by scrubbing with an alkaline solution. Ventilation is important in the potrooms to keep temperatures low and to remove fluorine compounds and dust from the room air. The large volumes of air withdrawn through the roof are usually cleaned with sprays or wet scrubbers. One new development is to clean the gases by absorption of fluoride on alumina followed by the removal of solid from the gas stream using bag filters. The costs and operating charges associated with the gas cleaning will vary with the design and location of the installation. The effects of fluorides on man and air quality standards are briefly discussed.

31567

Cook, C. C., G. R. Swany, and J. W. Colpitts

OPERATING EXPERIENCE WITH THE ALCOA 398 PROCESS FOR FLUORIDE RECOVERY. Air Pollution Control Assoc. J., 21(8):479-483, Aug. 1971. 1 ref.

Following the application of water scrubbers, cyclones, and electrostatic precipitators, Alcoa Research Laboratories at New Kensington, Pennsylvania, discovered that small quantities of hydrogen fluoride would react at low temperature with alumina. The Alcoa 398 Process was developed, incorporating a fluidized bed reactor to contact pot gases with incoming feed alumina. Bag filters are used to separate entrained solid materials from pot gases. Ninety-five percent interception of pot gases is reported with 99% recovery of fluorides from gases treated. Installation costs are in the range of $18-37 per annual ton for new installations and about 50% more for conversion of old plants. Direct operating costs range from $2.90 to $4.70/ton of aluminum and recover eight dollars worth of fluorine, giving a net credit. A general description of the Alcoa 398 Process is included, and applicability and limitations are discussed. Performance efficiency, effect on metal purity, and maintenance are mentioned.

31644

Dahlquist, Evald

ELECTROFILTERS. (Elektrofilter). Tek. Tidskr., 73(27):116-125, July 3, 1943. Translated from Swedish. Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, 29p., June 1957.

The history of electrofilters was reviewed. The modern electrofilter apparatus consists of high-tension machinery and a filter. The high-tension machinery consists of the instrument cabinet, a high-tension transformer, a mechanical high-tension rectifier, and a milliamperemeter. Filter theory was also discussed. An exponential formula for dimensioning electrofilters is based on two assumptions: the amount of powder precipitated at a certain point on the filter is proportional to the amount of powder present in the gas at that point, and the particles migrate toward the precipitation electrode with a constant velocity. Because of manufacturing costs, the tendency is to use plane filters rather than tube filters. Applications of electrofilters include quartz dust factories, smelter dust, sulfur trioxide, tar, sulfur, and aluminum oxide.

32319

Konopka, A. P.

PARTICULATE CONTROL TECHNOLOGY IN PRIMARY NON-FERROUS SMELTING. Preprint, American Inst. of

Chemical Engineers and Inst. Mexicano de Ingenieros Quimicos, 10p., 1970. 9 refs. (Presented at the American Institute of Chemical Engineers and Institute Mexicano de Ingenieros Quimicos Joint Meeting, 3rd, 0Denver, Colo., Sept. 1970.)

The sources and nature of particulate emissions and control technology in the primary smelting of aluminum, copper, lead, and zinc are described. The high dust concentrations generated by bauxite drying and alumina calcining frequently require multicyclones for preliminary collection, followed by electrostatic precipitation. Installed costs for the combined system are $4.60-$2.30/CFM, at 99+% collection efficiencies. Electrolytic aluminum reduction cells pose a more complicated emission problem: moderate-energy wet scrubbers, glass filter bags, or flushed precipitator installations are used. Representative installed costs for the three methods are $3.00/CFM, $2.00/CFM, and $2.00/CFM, respectively. Dry electrostatic precipitators, preceded by mechanical collectors, are universally applied in copper smelting. Installation costs for the combined equipment are $6.00/CFM for 50,000 CFM flows and $3.00/CFM for 2,000,000 CFM flows. Large lead blast furnaces employ electrostatic precipitators, smaller units use fabric filters. Installation costs of vertical flow pipe-type precipitators in the 100,000 CFM range are $6.00/CFM. Continuous baghouses for smaller volumes cost $5.00/CFM installed. Horizontal flow plate precipitators are used on new zinc sintering machines. Mild-steel construction is common, and installed costs for 50,000 CFM collectors are $3.50/CFM. Emissions from flash roasting of zinc ore are also controlled by plate-type precipitators of mild steel construction. Installed costs are $3.50/CFM.

32963

McClain, R. S., G. V. Sullivan, and W. A. Stickney

RECOVERING ALUMINUM AND FLUORINE COMPOUNDS FROM ALUMINUM PLANT RESIDUES. U. S. Bureau of Mines, Rept. 5777, 16p., 1961. 1 ref.

Residues from aluminum plants were investigated to determine if carbon could be removed by flotation while recovering fluorine and aluminum compounds for recycling to the reduction process. Samples of flue dust, pot skimmings, and pot linings all responded to a simple turpentine flotation scheme to reject 90-97% of the carbon. Aluminum compound recoveries were 42-94% on the flue dust, about 95% on the pot skimmings, and 75-89% on the pot linings. Fluorine recoveries from the same samples were 35-63, 92-95, and 77-86%, respectively. The pot linings contained soluble aluminum and fluorine salts that were recovered by precipitation with sodium aluminate and carbon dioxide gas. Composites of residues responsed to flotation much the same as the individual samples. (Author summary modified)

33918

Okumura, Eijiro and Hiroyasu Matsumoto

DESIGN OF FLOATING SCRUBBER AND TURBULENT ABSORBER. (Shisshiki shujin oyobi gasu kyushu sochi no sekkei - Furotingu sukurabba, taburento abusoba ni tsuite). Text in Japanese. Kagaku Sochi (Plant and Process), 9(10):11-22, Oct. 1967. 4 refs.

The Floating Scrubber (FBWS), wet type dust collection device, and the Turbulent Absorber (TCA), a gas absorption device, were discussed including their basic mechanisms, construction, and design theories. Practical applications include dust removal in iron manufacturing plants; dust removal, sulfur dioxide recovery, and gas absorption in pulp factories; dust removal in steel manufacturing dust removal in sulfuric acid manufacturing plants; absorption of SO2 from waste gas in H2SO4 manufacturing plants; recovery of fluoride compounds from waste gas phosphoric acid manufacturing industry and from waste gas in aluminum manufacturing industry. Both the FBWS and TCA are scrubber columns filled with lightweight plastic balls between two grids. The washing liquid is sprayed through a nozzle from above and the gas to be treated is fed in from below; the gas causes a violent turbulent motion as it ascends to contact the wash liquid. Since the gas-liquid contact system occurs in the space between the two grids, the balls contact the media, float with the gas and liquid. Since the gas-liquid contact system occurs in the space between the two grids, the balls contact the media, float with the gas and liquid, revolve, and hit each other, thus causing stirring. This keeps the surface of the balls clean so that a new liquid film can form. Also, the area of contact between the gas and the liquid is enlarged for effective dust collection and gas absorption. The constant stirring keeps the grid meshes free from viscous or other substances formed by the absorption reaction. This is known as self-cleaning. Both FBWS and TAC are patented to UPO of the U.S.A. and feature no clogging, even with viscous substances; low pressure loss compared with its high gas velocity; higher contact effect resulting in higher efficiency; and stable and long-life performance.

35115

Descolas, Jean

ACTION OF BUILDERS OF SEPARATORS AND OF SCRUBBERS. (Action des constructeurs de separateurs et epurateurs). Text in French. Pollut. Atmos. (Paris), vol. 13:48-51, Oct. 1971.

Dry dust arresters are steadily gaining over wet one because they eliminate the sludge problem. Still, the venturi scrubber has found wide application in the steel industry in the purification of gases from blast furnaces. Bag filters are also widely used because of their high efficiency and their dry dust recovery. Newer models tolerate higher temperatures than older ones, thus broadening their field of application (glass wool tolerates up to 315 C). Electric filters have also vastly improved (emission electrodes with increased mechanical resistance), as have scrubbers which absorb sulfur dioxide, fluorine, and other noxious or malodorous gases. Modern scrubbers work with solutions of various chemical compounds. An increasing number of industries is introducing them (the aluminum industry for fluorine control and the cellulose industry for the control of mercaptans). Of all dust arresters, cyclones account for 15%, wet dust arresters for 20%, electrical dry and wet dust arresters for 35%, bag filters for 25%, and other systems for five percent. The investment in dust arresters per capita in France comes to two Francs, thus France is in fifth place behind Sweden, United States, West Germany, and England. A 15-20% yearly increase in expenditures for purification equipment can be foreseen.

36552

Smith, Peter V.

ADVANCEMENT IN THE CONTROL OF PARTICULATES. Tennessee Univ., Knoxville, Proc. Ind. Air Pollut. Control Conf., Annu., 1st, Knoxville, Tenn., 1971, p. 56-71. 6 refs. (April 22-23.)

In addition to particulate control, the familiar collectors such as the precipitator, scrubber, mechanical collector, and fabric filterhouse can also remove gaseous emissions such as sulfur oxides, nitrogen oxides, chlorine, and fluorine. The precipitator can remove enough particulate matter to enable the gas

removal device to operate effectively, independently of the entrained particulate matter which could be detrimental to its operation. In many instances where upgrading fly ash removal of an existing boiler is necessary to meet new regulations, the use of scrubbers is preferred because their compact size is compatible with the amount of available land area. The most recent innovation in the use of electrostatic precipitators is the application of the hot precipitator to utility boilers firing low sulfur coal. In the aluminum industry, electrostatic precipitators have been used on prebake potlines. Packaged, low energy, venturi-slotted type scrubbers have been successfully applied to remove particulate emissions from apartment house incinerators.

36755

Cook, C. C. and G. R. Swany

EVOLUTION OF FLUORIDE RECOVERY PROCESSES. ALCOA SMELTERS. Tennessee Univ., Knoxville, Dept. of Civil Engineering, Proc. Ind. Air Pollut. Control Conf., Annu., 1st, Knoxville, Tenn., 1971, p. 145-157. (April 22-23.)

Fluoride recovery processes developed by Alcoa and various techniques of pollution control instituted in their aluminum plants are reviewed with respect to early history, development of gas cell technique and treatment facilities, dry process development, and the Alcoa-398 process. Wet scrubbers to capture gaseous fluorides, fume collection equipment, electrostatic precipitators, and filter bags comprise most of the control systems. The Alcoa-398 process consists of a fluidized bed of alumina, dust collector, conveyors for alumina transport, and storage space. Typical investment and operating costs are discussed.

37293

THE INAUGURATION OF THE NEW ALUMINUM PLANT PECHINEY IN VLISSINGEN BY PRINCE BERNHARD OF THE NETHERLANDS. (Einweihung der neuen Pechiney Huette Vlissingen durch Prinz Bernhard der Niederlande). Text in German. Aluminium, 47(12):782-784, Dec. 1971.

The new aluminum plant with 256 furnaces in Vlissingen (The Netherlands) has not been equipped with a central waste air cleaning system. After extensive experiments in the wind tunnel, it was decided to install individual groups of ventilators and gas scrubbers. The 34 ventilators with which the plant has been equipped have a throughput of 30 million cu m/hr, each ventilator has a throughput of 63 cu m/sec. In the gas scrubbers, 30,000 cu m water are atomized/hr for binding the fluorine gases. The fluorine is precipitated and recovered and returned to the production process. Air monitoring stations both of the stationary and mobile type are in operation to a distance of 18 km from the plant. The costs for installation of this system amounted to 1.68 million dollars, the power consumption amounts to 90 million kWh/yr.

37544

Burkat, V. S., E. Ya. Tarat, V. A. Baevshii, E. M. Voronin, and M. T. Tsurenko

PURIFICATION OF ALUMINUM-INDUSTRY GASES IN A HOLLOW HIGH-SPEED SCRUBBER. Soviet J. Non-Ferrous Metals (English translation from Russian of: Tsvetn. Metal.), 10(9):61-63, Sept. 1969. 3 refs.

A pilot gas purifier consisting of an electric separator and a hollow scrubber with spray nozzles was tested for its ability to remove gaseous and solid fluoride compounds from exhaust gases at an aluminum plant. The efficiency of gas purification in the scrubber was determined at gas linear velocities of 3-7 m/sec, gas inlet temperatures of 40-50 C, and spraying densities of 20 and 30 cu m/sq m/hr. Spray density had a greater influence on the degree of hydrogen fluoride entrainment than a change in gas velocity. The degree of purification remained constant within the gas-velocity range tested, but increased with an increase in spraying density. An equation is given that predicts the performance of the hollow, high-speed scrubber under various operating conditions.

38082

Schwegmann, J. C. and L. Leder

PURIFICATION OF ELECTROLYSIS-FURNACE FLUE GAS FROM ALUMINUM FOUNDRIES. (Abgasreinigung der Elektrolyseofen-Abgase von Aluminum-Huetten). Text in German. Luftverunreinigung, 1969:17-20, Oct. 1969.

A technique for the purification of waste gases emitted from the electrolytic cells of aluminum manufacturing plants is presented. The problems of withdrawing the gases from each cell individually or from the building housing the cells are reviewed. The best method of removing the gases from each cell is individual encapsulation. The exhauster must be designed to leave sufficient access to the cells but simultaneously prevent any emission of the waste gases into the work shop. A negative pressure must be maintained in the exhauster spanning the surface of the cell; removable sheet steel plates are installed on the sides. In cases where individual withdrawal is not feasible, centralized cleaning, using ventilators and scrubbers, is possible. Due to the great volumes of air to be drawn off in centralized cleaning, the cleaning efficiency of the diluted gases withdrawn centrally is much lower than that of the concentrated gases withdrawn individually. The process for individual withdrawal is reviewed. The control equipment consists of an exhaust system for waste gas drawing, cyclones for dust removal, scrubbers for removal of gaseous fluorine, and high stack discharge.

38188

Zhulin, N. V. and A. A. Komlev

USE OF FLOCCULANTS FOR PRECIPITATING PARTICLES IN GAS PURIFICATION SOLUTIONS. (Primeneniye flokulyantov dlya osazdeniya chastuts v rastvorakh gazoochistki). Text in Russian. Tsvetny. Metal., 8(44):36-37, 1971. 3 refs.

The effect of flocculants on the settling of suspended solids from sodium bicarbonate scrubber solutions used after the electrostatic precipitation of noxious gases from aluminum cells was examined. The solution contained approximately 25 g/l sodium fluoride, 53 g/l sodium carbonate and sodium bicarbonate, 47 g/l sodium sulfate, and 30 g/l suspended solids consisting of about 80% cryolite, aluminum fluoride, magnesium fluoride, and calcium fluoride and about 15% of calcination loss products, i.e., unburned coke and pitch. Decreasing the solution sodium sulfate concentration from 52 to 32 g/l and increasing the temperature from 20 to 50 deg increased the settling rate by 50 and 100%, respectively. Soap chips, sodium oleate, oleic acid, tall oil and its hydrolysis products, and hydrolyzed polyacrylamide accelerated the settling; of these, 30 mg/l of the hydrolyzed polyacrylamide was the best additive.

38775

Ryaguzov, V. N. and I. V. Kaydalov

EFFECT OF THE METHOD OF STOPPING THE ANODE EFFECT ON THE POLLUTION OF THE ATMOSPHERE WITH FLUORINE. (Vliyaniye sposoba grsheniya anodnogo effekta na stepen zagryazneniya atmosfery ftorom). Text in Russian. Tsvetn. Metal., 44(8):26-28, Dec. 27, 1971. 6 refs.

Fluorine salt losses and abatement of air pollution with fluorine from aluminum producing plants can be achieved by substituting the use of wood pulp or other hydrogen containing compounds with compressed air in the extinguishing of the anodic effects. However, the wide use of this procedure was prevented because of the explosion hazards involved, if the air included humidity drops. An air drying device should be applied before its use for this purpose. Since each hydrogen atom introduced into the electrolyte system produces an emission of one fluorine atom, and the carbon constituent of the wood pulp produces contamination of the electrolyte and thus increases its electrical resistance, the advantage of the compressed air use is emphasized.

38823

Bender, Rene J.

AIR POLLUTION CONTROL: ITS IMPACT ON THE METAL INDUSTRIES. Power, 116(4):56-60, April 1972. 1 ref.

While the control of air pollution can be accomplished readily in a reasonable period of time by the larger steel, aluminum, and nickel producers, and with a little greater effort by the largest copper and copper-derivative companies, it can have disastrous consequences upon small, low-capital enterprises. One of the most difficult problems in the steel industry is to eliminate emissions while loading and unloading coke ovens. The basic oxygen process, bag houses, and other steps being taken by the steel companies to modernize their equipment to maintain a clean environment are mentioned. Tall chimneys and electrostatic precipitators are being utilized by the nickel industry, while a new molten aluminum fluxing process and a chemically coated filter-bag system are under development for the aluminum industry. The effect of strict emission regulations on the copper industry and the plight of small foundries are mentioned. Costs for pollution cleanup are given.

38874

Fialkov, Yu. G., M. L. Cherkasskiy, V. S. Malts, and B. P. Gromov

INDUSTRIAL HIGH-SPEED HOLLOW SCRUBBER FOR ALUMINUM MANUFACTURING-GENERATED GAS CLEANING. (Promyshlennyy polyy skorostnoy skrubber dlya ochitski gazov alyuminiyevogo proizvodstva). Text in Russian. Tsvetn. Metall., no. 12:28-31, Dec. 1971. 4 refs.

Scrubbers with diameters exceeding 5 m used in electrolysis shops were investigated. Before scrubber treatment the gas to be cleaned contained, per N cu m, 10-30 mg hydrogen fluoride, 30-100 mg dust, and 10-60 mg tar. The scrubber was sprayed with soda solution as an absorbing agent. Hydrogen fluoride absorption was dependent on the linear gas velocity and the spray density. The efficiency could be influenced by the site and direction of the spray. Spraying from the topside gave the best result up to a gas speed of 5 m/sec. The effects of the spray density were studied under various spraying conditions. Efficiencies of 97.5-98.0% were reached with a density of 37 cu m/sq m.hour. Single-stage dust separation and scrubbing were applied in the hollow scrubber. Increased gas speed and spray density resulted in increased efficiency, while the nozzle placement had only a slight influence. The residual dust concentration was 30-60 mg/N cu m. Efficiency for total dust was 73% with a gas speed of 3.3 m/sec and a spray of 30 cu m/sq m.hour. Efficiencies above 90% can be reached with appropriate gas velocities and spray density. The drop separator had a hydraulic resistance of 15-20 kg/sq m.

39434

Tomany, James P.

THE CONTROL OF ALUMINUM CHLORIDE FUMES. Light Metal Age, 26(9/10): 19-20, 36, Oct. 1968. (Presented at the Air Pollution Control Association, Annual Meeting, 61st, St. Paul, Minn., June 23-27, 1968.)

Chlorine, hydrogen chloride, aluminum chloride, and aluminum oxide may be produced from aluminum processing furnaces. The latter two contaminants are in the form of solid particles which if untreated, will produce a white plume of varying density at the stack. Flow rates and other process conditions are indicated. Bag filters will collect a reasonable amount of the particulates, but they may become clogged by the hygroscopic aluminum chloride, while the elevated temperatures of the hot gases create a fire hazard. The collecuon of particulates in aluminum processing requires scrubbing with alkaline solutions in equipment which will not plug. The UOP floating-bed scrubbing system for handling aluminum chloride fumes is described. The major process variables which determine the scrubber design are the chlorination rate, the chlorination cycle, and the size and type of melt furnace.

39519

Muhlrad, W.

THE PROBLEM OF THE SMOKES EMITTED BY ELECTROMETALLURGICAL FURNACES. (Probleme des fumees emises par les fours electrometallurgiques). Chaleur Ind., no. 422:237-255, Sept. 1960. 6 refs. Translated from French. 53p.

Problems, techniques, and equipment involved in controlling smoke from electrometallurgical furnaces are considered. The dusts from electric furnaces are extremely fine, and the topographic locations of most of the factories favor inversions. The characteristics of different types of furnaces and the nature of their smoke emissions are described. Ferrosilicon furnaces, ferromanganese and ferrosilicon-ferromanganese furnaces, ferrochrome and ferrosilicon-chrome furnaces, ferrotungsten furnaces, ferronickel furnaces, calcium carbide furnaces, and aluminum electrolysis tanks are included. Dust filtration, precipitators, and scrubbers are indicated for control purposes.

42287

Bamag Verfahrenstechnik G.m.b.H. Butzbach (West Germany)

REMOVAL OF FLUORINE FROM WASTE GASES. (Entfernen von Fluor aus Abgasen). Text in German. Umwelt (Duesseldorf), 2(3):62-64, June-July 1972. 4 refs.

Aluminum plants emit waste gases containing at times 150/mg/cu m elemental fluorine or fluorine compounds. For each ton of crude aluminum produced, the plants emit 4 kg or more of fluorine. The waste gases of superphosphate plants contain volumetric concentrations between 0.5 and 1.0% silicon tetrafluoride according to some sources even up to 3% gaseous fluorine components. The design and operation of a waste air cleaning plant for a test stand for rocket engines is described. The waste air enters the cleaning system below the packed layer of a scrubber and passes countercurrent to the scrubbing fluid, an aqueous solution of potassium hydroxide. For removal of the droplets of scrubbing fluid which are carried along by the air another packed layer is arranged ahead of the exit to the stack. The scrubbing fluid enriched with fluorine is recovered, the sludge which accumulates at the recovery is subjected to special treatment for conversion of the fluorine compounds into harmless calcium fluoride. After this treatment it can be dumped.

42458

Lobos, J. S., J. P. McGeer, and D. P. Sanderson

REACTIVITY OF ALUMINA TOWARDS HYDROGEN FLUORIDE. Preprint, American Inst. of Mining, Metallurgical, and Petroleum Engineers (AIME), New York, N. Y., 10p., 1971. 2 refs. (Presented at the American Inst. of Mining, Metallurgical and Petroleum Engineers, Annual Meeting, New York, Feb. 26-March 4, 1971.)

A simple method was developed to measure reactivity of alumina toward hydrogen fluoride. The apparatus consisted of a heated alumina desiccator. A platinum dish containing a known volume of HF solution was placed in the lower compartment and the desiccator was allowed to heat to a desired temperature. Weighed samples of the alumina in 40 ml platinum crucibles were then placed in the upper compartment. After a known length of time the samples were removed, put in an ordinary desiccator and after cooling analyzed for fluoride. Alpha-type alumina was about 10 times less reactive than the gamma-type. In plant tests using various dry scrubbing systems for pot gases, the gamma-type alumina absorbed over 2% fluorine in a fraction of a second. Other relationships between absorption of fluorine and alumina properties such as degree of calcination and reactivity towards water were investigated. Preliminary operation of a two-stage cell gas scrubbing system with a cyclone incorporated demonstrated flexibility and a number of other benefits, including segregation of impurities such as iron and phosphorus and economic tar fume handling.

43299

Iversen, Reid E.

AIR POLLUTION CONTROL: ENGINEERING AND COST STUDY OF THE PRIMARY ALUMINUM INDUSTRY. Preprint, American Inst. of Mining, Metallurgical and Petroleum Engineers, New York, Metallurgical Society, 22p., 1972. 3 refs. (Presented at the American Institute of Mining, Metallurgical and Petroleum Engineers, Metallurgical Society, San Francisco, Calif., Feb. 22, 1972.)

Gaseous and particulate Fluorides are the most serious pollutants emitted from aluminum reduction plants. Other pollutants such as cryolite, aluminum fluoride, calcium fluoride, chiolite, hydrocarbons, and carbon have been identified. The gaseous emissions, in addition to the fluorides, have been identified as carbon monoxide, carbon dioxide, sulfur dioxide, nitrogen oxides, hydrogen sulfide, carbonyl sulfide, carbon disulfide, silicon tetrafluoride, and hydrogen fluoride. The greatest source of pollutants of all types is normally at the individual electric cells or pot lines. The anode bake plant is potentially the second greatest source. Emissions from an uncontrolled prebake potline have been measured at 92 lb/t Al, total solids, 60 lb/t SO2, and 46 lb/t total F as well as volatilized hydrocarbons. Primary controls collect emissions at the pot head; secondary controls are located in the roof monitor area. About 75% of the plants in the U. S. have primary controls only, 7% have primary and secondary, 15% have secondary controls only, and 3% have no controls. The industry as a whole showed an emission control factor for total F of 73%. This amounts to 12 lb gaseous/t of Al and 19 lb/t for solids. A well designed pre-bake plant with primary and secondary controls could reduce emissions to 1.6 lb/t gaseous and 5 lb/t solids. Annual costs to the industry for control devices are now $58/T for capital and $16/T for operating expenses. Control systems include baffles, spray towers, wet cyclones, packed towers, bubbler towers, venturi scrubbers, mechanical collectors, multicyclones, electrostatic precipitators, bag filters, absorption, and fluidized beds.

43840

Hemming, Charles

WHAT INDUSTRY IS DOING ABOUT POLLUTION CONTROL. Civil Eng. (N. Y.), 41(9):59-62, Sept. 1971.

Developments in air and water pollution control by five major industries are reviewed. Hercules, Inc. is constructing an advanced solid-waste reclamation plant in Delaware that will convert 500 tons of refuse and 70 tons of sewage sludge/day into marketable products. Dow Chemical Company has a number of projects underway at its Midland, Michigan, Division, including brine purification, the installation of detection devices on sewers, and environmental monitoring in the form of a specially designed van which tours potential trouble areas around the plant. Alcoa has perfected a system for recycling fluoride effluents in smelting operations. The fumes given off in a aluminum smelting, heavy with particulate and gaseous fluorides, are ducted through a bed of alumina which chemisorbs the gaseous fluoride. Particulate fluoride is captured in filter bags. Recovered fluorides are recycled to potline cells where they contribute to the continuous smelting process. The Alcoa 398 Process is more than 99% efficient in recovering potential pollutants. General Motors is active in planning abandoned-car cleanup campaigns. Allied Chemical Corporation has developed a pipeline-charging system that controls air pollution resulting from coke ovens by reducing smoke and gases from by-products by as much as 70%.

44343

Waki, Koichi

ALUMINUM REFINERIES. (Aruminyumu seirenjo). Text in Japanese. (Kinzoku Zairyo (Metals in Engineering), 12(5):45-51, May 1972. 19 refs.

Pollution at aluminum refineries and its control is discussed. The major material for the production of aluminum by the electrolytic method is cryolite to which aluminum trifluoride is usually added to increase the current efficiency, decrease the melting point, and protect the electrolyzer. The addition results in the formation of sodium aluminum tetrafluoride, which is volatile and reacts readily with water vapor to form hydrogen fluoride. The amount of fluoride discharged depends largely on the residue hydrocarbon on the anode, the alumina in electrolyzer, and the temperature and bath ratio. A combination of dust collector, such as a cyclone or an electrostatic precipitator, for the removel of particulates, and a washing tower for the removal of HF gas is used for the purification of flue gas from Al refineries.

44838

Rush, Dumont, John C. Russell, and Reid E. Iversen

EFFECTIVENESS AND COST OF AIR POLLUTION ABATEMENT ON PRIMARY ALUMINUM POTLINES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 23p., 1972. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-78.)

Effluent data from aluminum potlines permits the construction of models of smelter effluents, representative of present practice in the United States, which may be acted upon in accordance with various demonstrated collection and removal efficiencies of control systems and their costs in order to evaluate the cost-effectiveness of various control schemes and to estimate the costs involved in upgrading pollution abatement in the industry. Representative capital and operating costs and removal efficiencies for a number of kinds of applicable control equipment have been developed and organized in a way which permits approximate evaluations among alternative ap-

proaches to pollution abatement. The application of the best demonstrated pollution abatement technology to the collected primary effluents from aluminum potlines would result in representative total fluoride emissions of from 1.2 to 4.7 lbs/1000 lbs of aluminum produced depending on the type of potline. The addition of scrubbing equipment on the secondary or building ventilation streams would reduce total fluoride emissions to the range of 0.8 to 2 lbs/1000 lbs aluminum, at considerably increased costs. A systems analysis was applied to the entire United States aluminum production industry showing the expected costs and performance parameters associated with upgrading the industry control from the present 74% to four higher levels of control. This analysis indicates that the application of best demonstrated control technology to the entire industry would raise overall control efficiency from 74 to 92%; it would increase invested industry capital for pollution control from $51 to $175/ton capacity, and would raise the industry operating cost of pollution abatement from $13 to $43/ton of aluminum produced at capacity. Pollutants from aluminum smelters include fluoride, hydrogen fluoride, alumina, particulates, and sulfur oxides. Control equipment includes scrubbers, electrostatic precipitators, cyclones, venturi scrubbers, and lime desulfurization.

45078

Robinson, J. M., G. I. Gruber, W. D. Lusk, and M. J. Santy

ENGINEERING AND COST EFFECTIVENESS STUDY OF FLUORIDE EMISSIONS CONTROL. (FINAL REPORT). VOLUME II. Resources Research, Inc., McLean. Va. and TRW Systems Group, McLean, Va., Office of Air Programs Contract EHSD 71-14, APTD 0944, 171p., Jan. 1972. 1026 refs. NTIS: PB 209647

The appendix and bibliography of a report on the costs of fluoride emissions control are presented. Two general types of pollution control equipment are currently used for fluoride emissions, wet collection equipment and dry collection equipment. The majority of capture devices used for fluoride removal are of the wet type. Wet collection systems simultaneously remove gaseous and particulate pollutants. The types of wet collection equipment described include: spray towers, packed bed scrubbers, wet cyclones, self-induced spray scrubbers, orifice plate bubblers, venturi scrubbers, jet scrubbers, and dynamic wet scrubbers. Under certain conditions, dry collection systems have been applied to fluoride emissions control. Three main classes are available: mechanical collection equipment, such as settling chambers, baffle chambers, skimming chambers, louver type collectors, dry cyclones, impingement collectors, and dry dynamic collectors; electrostatic precipitation; and fabric filtration. Inventories of industrial plant locations and capacities were prepared for the industries which are known or potential sources for fluoride emissions. The industries covered include: phosphate rock processing, iron and steel production, primary aluminum smelting, coal burning, steam electric power generation, hydrogen fluoride production; clay products, glass products, enamel frits, and non-ferrous metal smelters. A bibliography containing more than 1000 references is included.

47274

Adama, Robert J. and Carson L. Brooks

TRIGAS FLUXING. J. Metals, 24(8):21-24, Aug. 1972.

Fluxing of molten metal with a mixture of chlorine, carbon monoxide, and nitrogen (trigas) to remove suspended nonmetallic particles, as well as hydrogen gas, is described for the manufacture of aluminum. This mixture of three gases also dramatically reduces the amount and visibility of stack effluent as compared with that from chlorine fluxing. The results of test runs with a trigas system are indicated, and compared to results from a chlorine system.

47463

Hoeke, Engelbert

WET REMOVAL OF DUST FROM FLUORINE-CONTAINING EXHAUST GASES IN ALUMINUM MANUFACTURE. (Verfahren zur Nassentstaubung fluorhaltig Abgase bei der Herstellung von Aluminium). Text in German. Fried Krupp G.m.b.H., Essen (West Germany)) W. Ger. Pat. Appl. 2,039,568. Aug. 8, 1970. (3 claims).

Dust in fluorine-containing exhaust gases from aluminum manufacture can be removed by a wash solution with a pH equal to or greater than 10.5 and a salt content of less than 6%. The salt concentration can be maintained by replenishing the washing solution with fresh water.

48423

Weisburd, Melvin I.

PRIMARY AND SECONDARY NON-FERROUS SMELTING AND REFINING. In: Field Operations and Enforcement Manual for Air Pollution Control. Volume III: Inspection Procedures for Specific Industries. Pacific Environmental Services, Inc., Santa Monica, Calif., Office of Air Programs Contract CPA 70-122, Rept. APTD-1102, p. 7.8.1-7.8.50, Aug. 1972. 6 refs.

The smelting and refining of non-ferrous metals are primarily concerned with the production of copper, lead, zinc, and aluminum ingots and alloys. Primary smelters usually constitute large, difficult to control single sources of air pollution, are usually located outside of urban areas, and can be significant sources of visible emissions and plant damage. Secondary smelters are commonly found in industrial and urban areas, close to sources of scrap and other raw materials generated by population centers. They are significant sources of pollution, as well as local public nuisance problems. Sources of emissions, processes, and inspection points are discussed for primary and secondary non-ferrous smelting and refining. Roasting, reverberatory furnaces, converters, and contaminants emitted are included for copper production. Sintering, blast furnaces, refining, and contaminants emitted are included for lead production. Roasting, sintering, extraction, and contaminants emitted are included for zinc production. Operations and equipment for reclaiming metals from scrap, drosses, and slag are considered, for brass and bronze, lead, zinc, and aluminum. Smoke, dust, fumes, sulfur oxides, fluxing, and degreasing agents are typically emitted.

C. MEASUREMENT METHODS

03940

A. S. Filatova, A. I. Kuz'minykh, F. D. Vedernikova, N. S. Solomennikova

DETERMINATION OF 3,4-BENZPYRENE LIBERATED BY SUBLIMATION OF ANODE MATERIAL IN ELECTROLYTIC SHOPS OF ALUMINUM PLANTS. Hyg. Sanit. 31, (4-6) 381-4, Apr.-June 1966. Russ. (Tr.) CFSTI, TT 66-51160/4-6

An investigation of the group of neutral multinuclear cyclic hydrocarbons with the intention of subsequent isolation and quantitative determination of 3,4-benzpyrene which is the most actively carcinogenic hydrocarbon was undertaken. Samples at the electrolytic shop of an aluminium plant of dust from the anode, from the inlet connector of the cell, from the anode pin and from the 'fog' evolving from under the pins as well as at the position occupied by the operator were taken. Air was drawn at a rate of 20 l/min through a filter made of the FPP-15 fabric fixed on a steel funnel, taking larger volumes of air in order to concentrate the small quantities of 3,4-benzpyrene assumed to be present. Since the carrier of carcinogenic substances is represented by tarry substances, the dust samples were extracted in a Soxhlet apparatus and quantitative determinations were made of the yield of tarry substances. Non-fluorescent benzene was used as the solvent. From the complex mixture of tarry substances by 3,4-benzpyrene was isolated by partition paper chromatography and fluorescence. The contents of 3,4-benzpyrene in the air samples taken in the electrolytic shop of an aluminum plant were as follows: 0.0137 to 0.022 1 micrograms/l at the worksite, 0.0361 to 0.2250 micrograms/l during the removal of the pins and 0.0519 to 1.3200 micrograms/l in the 'fog' issuing from under the anode pins.

14897

Centre Departemental d'Etude des Pollutions Atmospheriques, Paris, Section Sante et Meteo.

A DAY OF POLLUTION IN THE LACQ REGION. (Journee de pollutin vecue dans la region de Lacq). Text in French. Pollut. Atmos. (Paris), 11(Special):36-40, Feb. 1969.

Observations and measurements of pollution are reported for the period from Oct. 4 to 5, 1968, in the 15 km-wide valley of the Gave de Pau. On the night of Oct. 4, a 4-day old descending inversion reached an 11-degree amplitude with a 700-m thickness. Early morning pollution was near zero, but as the fog cleared and wind conditions of less than 1 knot prevailed, pollution indices rose greatly. Later in the day the wind rose, and in the absence of any inversion, pollution dropped by a factor of 10. A gas desulfurization plant in the valley emits 500 to 1000 tons of sulfur dioxide daily. Measurements made by absorption of acid gases in glycerinated 0.5 NaOH, in hydrogen peroxide solution, or in glycerinated zinc acetate gave qualitatively similar results. Emissions were from a 104-m high chimney, but maximum ground level pollution was found 5 km from the chimney, a distance about 40 times the theoretical chimney height, i.e., the plume height above the chimney. Another source of pollution in the valley is an aluminum extraction plant which employs the Soderberg process and emits 150 kg per day of fluoride ions. Measurement by exposure of lime-impregnated papers, with colorimetric estimating techniques, correlated in 70% of the cases with direct absorption on fiberglass, and was reproducible to better than 10%. Decrease of pollution with distance was found to be exponential, with the worst pollution occurring within 2 km of the plant.

15372

MAINTENANCE OF AIR PURITY AND DETERMINATIONS OF IMMISSION BY THE ALUMINUM INDUSTRY: FLUORINE POLLUTION, ESPECIALLY HYDROGEN FLUORIDE GAS, IN WASTE GASES CAUSES DAMAGE TO VEGETATION. (Luftvard och immissionskontroll i aluminiumindustrin: fluorforeningarna, sarskilt det gasformiga fluorvatet, i avgaserna). Text in Swedish. Tek. Tidskr., 99(12):251-253, May 27, 1969.

The Sundsvall aluminum plant, the only alumina-electrolysis plant in Sweden, operates 300 cells currently producing 65,000 tons of Al per year, representing a fivefold increase of production since 1962. To date the company has spent 20 million kronor (about $4,000,000 in 1969) on air pollution control equipment, but there is still some damage to vegetation from hydrogen fluoride gas. Comfort of workers requires 20 to 30 changes of air per hour (12 million cu m/hr) in pot-line area, which complicates air pollution control. Most recent of several air-washing devices used in a 'spin bath' in which plastic balls are sprayed with water from jets. Exhaust gases escape through four 70-m concrete chimneys, 10-11 m in diameter and lined internally with plastic. The equipment removes 90% of water- soluble fluorides from exhaust. The company also maintains 160 inspection stations in the area, which by means of pollutant- sensitive plants record the immission of toxic material, which is the basis of a map of Sundsvall region with 'isofluoride' lines to indicate pollution zones.

17098

Radczewski, O. E.

FINE POWDERS (DUSTS) IN NATURE AND IN INDUSTRY, THEIR DETERMINATION AS CONTAMINANTS AND DETERMINATION OF FLUORINE COMPOUNDS IN THE AIR. (Feine Teilchen (Staeube) in Natur und Technik, ihre Bestimmung als Verunreinigungen und der Nachweis von Fluorverbindungen in der Luft). Text in German. Ber. Deut. Keram. Ges., 45(11):551-556, Nov. 1968. 9 refs.

The morphological significance of particles for their properties and the demonstration of industrial powders in the form of photographs and samples was presented. Electron diffraction is an important method because it allows a clear identification of extremely fine particles. Kaolinite and illite can be distinguished from each other or amorphous silica can be detected in Kaerlich clay. Contaminants in the air surrounding an aluminum factory were collected and electron-optically studied. Crystalline impurities in the atmosphere and the type and bonding of fluorine compounds in the exhausts of furnaces and kilns was also investigated with an electron-optical device.

An unequivocal determination was made possible by examining cell sizes in the selected area of diffraction and by measuring the angles between the different lattice directions. The results showed that chlorides, sulfates, and fluorine compounds were present in the air above the North Sea and in the exhaust gases of an aluminum smelting furnace. (Author summary modified)

29738

Moser, E.

MEASUREMENT OF GASEOUS AND PARTICULATE FLUORINE EMISSIONS. (Messung von gas- und staubfoermigen Fluor-Emissionen). Text in German. VDI (Ver. Deut. Ingr.) Ber., no. 164:91-99, 1971.

The emission from manufacturing plants which produce or process fluorine bearing products usually comprises a gaseous part and a particulate part. The gaseous part contains predominantly hydrofluoric acid, whereas the fluorine compounds in the dust may be composed of sodium fluoride, aluminum fluoride, cryolite, sodium silicofluoride, and calcium fluoride. With regard to the gaseous components, for instance in the case of an electrolytic aluminum smelting plant, where the emission of pollutants rises drastically at the time of metal pouring, charging of raw materials, and changing of electrodes, it is necessary to extend the sample taking at least over one complete cycle. For determination of peak concentrations, short time sampling is advised. In a plant with installed air purification, the air has to be sampled at points of entry and of exit of the purification system. An automatically working system of sample taking is described. The apparatus is divided into two groups, one of which is mounted directly next to the measuring point and comprises the filtering apparatus and gas absorption bottles, including a drip separator and a heater for the filters. The second group, connected by a hose line to the first, and conveniently located on the floor, comprises the pump arrangement with valves, thermometer, flow meter, and other necessary instruments. Tubular filters are lately being preferred to flat ones, due to their larger surface and better adaptability to the mounting of electric heaters. Absorption of gaseous HF in the bottles is best effected by a caustic soda solution.

30958

Monteriolo, S. Cerquiglini and A. Pepe

COMPARATIVE STUDY OF METHODS FOR THE DETERMINATION OF AIRBORNE FLUORIDES. Pure Appl. Chem., 24(4):707-714, 1970. 17 refs. (Presented at the International Symposium on the Chemical Aspects of Air Pollution, Cortina d Ampezzo, Italy, July 9-10, 1969.)

Some methods for the determination of gaseous and particulate fluorine compounds present in the air as pollutants are described and compared. Particulates were collected by means of membrane filters; gaseous compounds were sampled by absorption in alkaline solution. The operation included air and stack sampling, the separation of fluoride from interfering substances, and its final determination. Results obtained for the separation of fluoride by distillation and by other microdiffusion techniques are presented. The application of various methods to the subsequent determination of fluoride are also discussed. Spectrophotometric methods were used for the final quantitative determination of the fluoride content. It is concluded that when an aluminum smelter is involved, the mean amounts of fluoride, collected in a five kilometer area surrounding the plant, are higher than five micrograms, with values as high as 375-500 micrograms for 24 hours of sampling. (Author abstract modified)

33045

Triplett, Gary

ESTIMATION OF PLANT EMISSIONS. Preprint, p. 15-27. 1970 (?). 21 refs.

There are times when it is not possible or practical to determine emission rates by stack sampling; in these cases emission rates may be estimated by utilizing available emission factors. An emission factor is the statistical average of the mass of contaminants emitted/unit quantity of material handled, processed, or burned. The emission factor may also be expressed as the quantity of contaminant/unit quantity of final product or effluent volume. These factors have been developed through stack testing or by material balance calculations. Emission factors are normally given in terms of uncontrolled emissions. Therefore, the type and effectiveness of control equipment must be considered when calculating emissions from controlled sources. Particle size distribution and effective stack height should also be considered. Emission factors are given for coal, fuel oil, natural gas, and wood burning; solid waste disposal; incinerators; paint manufacturing; the food and agriculture industry; primary metallurgical processing including iron and steel manufacturing, open hearth furnaces, basic oxygen furnaces, electrical arc furnaces, and blast furnaces; smelting and foundries for aluminum, brass, lead magnesium, steel, and zinc; mineral processing of asphalt, calcium carbide, cement, concrete, glass and lime; petroleum production, and the kraft pulp industry. (Author abstract modified)

37107

Malakhina, A. Ya., M. I. Til kov, and Yu. K. Shaposhnikov

PAPER CHROMATOGRAPHY OF POLYNUCLEAR AROMATIC HYDROCARBONS. (Bumazhnaya khromatografiya poliyadernykh aromaticheskikh uglevodorodov). Hyg. Sanit. (English translation from Russian of: Gigiena i Sanit.), 36(1-3):97-100, Jan.-March, 1971. 7 refs. NTIS: TT 71-50122

Acetone, benzene, or octane extracts of polynuclear aromatic hydrocarbons (PAH) in dusts at three aluminum works were separated by paper chromatography and analyzed by thin-layer chromatography or fluorometric spectroscopy. The following PAH were determined in dusts deposited in ventilation pipes during the manufacture of electrolytic aluminum: 20-methylcholanthrene, 3,4-benzypyrene, 1,2-benzpyrene, 1,2-benzanthracene, 1,3,3,4-dibenzanthracene, 9,10-dimethyl-1,2-bezanthracene, and anthracene. The compounds were quantitatively determined by cutting out chromatogram spots and eluting them into a solution followed by fluorometric analysis. The 3,4-benzpyrene concentrations in 1-gram dust samples from the three plants were 0.051, 0.039, and 0.042 mg, respectively. The method is also applicable to investigations of PAH in gaseous discharges and effluents.

38905

Haneda, Mikiko and Tsunoda, Fumio

MEASUREMENTS OF AIR POLLUTION BY FLUORIDE BY MEANS OF THE LIME TREATED FILTER PAPER METHOD. (Lime treated filter paper ho ni yo fukkabutsu no ta taikiosen sokuteiho). Text in Japanese. Kankyo Hoken Report. (Environ. Health Rept.), no. 8:23-30, Jan. 1971. 22 refs.

Measurements were carried out for fluoride within a radius of 5 km from the aluminium factory, which was considered as a source of pollution, using the Lime Treated Filter Paper method reported by Miller, and Adams, and also the followup measurements were taken to prove the usefulness of this method. Paper filter No. 51A was used in the LTP method. The filters were treated with 1% lime suspension and when they were dried, exposure was made. Two or three LTP were

placed in the air screen at six spots which were located in the different distances and directions from the source of pollution. The variation coefficient of the values obtained from within the premises of the factory was 22.3%. The variation coefficients of values in the polluted area outside of the factory were 3.8 - 8.9% and the average of them of 8.7%. As for the relationship between the exposure duration of LTP and the accumulated amount of fluorine, decreased amounts were observed on the eighth week. Any correlation was not seen between the values obtained by the LTP method and the fluorine amount in soluble components by the dust fall method.

40705

Desbaumes, Paul, Eric Desbaumes, and Claude Imhoff

USE OF A FLUIDIZED SILICAGEL POWDER BED ABSORBER FOR THE MEASUREMENT OF FLUORINE EMISSIONS AND IMMISSIONS. (Emploi d un absorbeur a lit fluidise de poudre de gel de silice pour la mesure des emissions et immissions de fluor). Text in French. Pollut. Atmos. (Paris), 14(53):56-61, Jan.-March 1972. 6 refs.

A portable fluidized silicagel powder bed absorber, developed for the sampling of fluorine emissions, was tested in an artificial atmosphere and in an aluminum plant area, and compared to conventional alkaline absorbers. The silicagel powder was impregnated with 3% alcoholic solution of triethanolamine, and then dried at 100 C. The sampling rate applied was 2 l/min. A comparative test of three different techniques for the extraction of the fluoride from the silicagel (maceration, maceration with simultaneous agitation, and elution) revealed the superiority of the latter method which had a maximum efficiency of 99%, depending on the amount of hot water used. Tests with different hydrofluoric acid concentrations revealed a slight decrease (below 99%) in the absorbing capacity of the fluidized silicagel bed absorber for concentrations exceeding 5 mg of F/cu m. The fluorine determination in samples from an aluminum plant area was made by means of the Belcher-West-Sulzberger method, using alizarine complexion and a sodium hydroxide solution as standard solutions.

41064

Boyev, I. Ya., Ye. G. Levkov, V. A. Limanskiy, V. P. Bugayev, and A. S. Levkova

SAMPLING, SEPARATION AND FLUORINE DETERMINATION TECHNIQUES IN ALUMINUM MANUFACTURING PLANT-PRODUCED ELECTROLYSIS DUSTS. (Metodika otbora prob, otdeleniya i opredeleniya ftora v elektroliznykh pylyakh alyuminiyevogo proizvodstva). Text in Russian. Zavodsk. Lab. (Moscow), 38(3):278-281, 1972. 3 refs.

Various filter materials were tested and optimum conditions of fluorine separation and determination were determined. The dust samples were collected with a 0.074-micron filter made of carbon fibers. The retention for finely dispersed dust was above 99%. Preliminary extraction of hydrocarbons by benzene or trichloroethylene was followed by high-efficiency hydropyrolytic separation in the presence of vanadium pentoxide as catalyst. The optimum conditions for the above procedure were a maximum temperature of 1100 C in the reaction zone, 95 C in the steam generator, a vapor-air mixture flow rate of 1.2 l/min, a dust sample-to-catalyst ratio of 1:1, and a reaction time of 60 min. The hydrogen compounds of fluorine that were obtained were absorbed in a basic solution. A current measurement method, based on the Zirconium substitution of iron ions in their fluoride complexes, was used for analysis. Titration with zirconium oxichloride was made after hydrochloric acid was added. The recording of the equivalent points provided high accuracy. A platinum electrode and saturated calomel were applied as reference electrode.

43371

Hanna, Thomas R. and Michael J. Pilat

SIZE DISTRIBUTION OF PARTICULATES EMITTED FROM A HORIZONTAL SPIKE SODERBERG ALUMINUM REDUCTION CELL. J. Air Pollution Control Assoc., 22(7):533-536, July 1972. 4 refs. (Presented at the Pacific Northwest International Section-Air Pollution Control Association, Annual Meeting, Nov. 1970, Paper 70-AP-12.)

Aerosol size distributions were measured in the air exhausted from a horizontal spike Soderberg aluminum reduction cell at the Kaiser Aluminum and Chemical Corporation plant in Tacoma, Washington. The particle size distributions were measured with the University of Washington cascade impactor. Particle mass concentrations and size distributions were found to vary significantly with changes in the cell process operations. For a typical aerosol size distribution at the exit of the cell hood the mass mean particle diameter was 5.5 micron and the particle size standard geometric deviation was 25. (Author abstract modified)

44689

Lemoine, R.

MONITORING METHODS FOR THE GASEOUS EFFLUENTS OF ALUMINUM PLANTS. Preprint, American Inst. of Mining, Metallurgical, and Petroleum Engineers (AIME), New York, N. Y., 10p., 1972. (Presented at the American Inst. of Mining, Metallurgical, and Petroleum Engineers Annual Meeting, New York, Feb. 26-March 4, 1971.)

The methods used by aluminum plants to monitor gas-scrubbing processes are still rather empirical and the rigorous distinction between gaseous and solid fluorides is not possible due to the lack of precise knowledge of the adsorption and desorption properties of the solids. It is very difficult to get an accurate measure of the gas flow, and thus to know the actual amount of released fluorides. There is a pressing need for international standardization, mainly in sampling methods, to allow the aluminum producers to make process comparisons. These same difficulties exist for ambient air measurements of gaseous and solid fluorides. The relative toxicities of the solid fluorides are not well understood. Two general approaches exist for measuring the atmospheric concentration of gaseous fluorides. Automatic apparatus give punctual short-term data, but this data requires further data processing and the equipment is expensive. The inexpensive static methods in existence yield abundant but inaccurate data. Sampling procedures are discussed and special precautions for avoiding the common pitfalls of fluoride determination are outlined.

D. AIR QUALITY MEASUREMENTS

14066

Hluchan, E., J. Mayer, and E. Abel

AMBIENT POLLUTION FROM FLUORINE COMPOUNDS IN THE NEIGHBORHOOD OF AN ALUMINUM FACTORY. (Inquinamento ambientale da composti del fluoro nelle vicinanze di una fabbrica di alluminio). Text in Italian. Med. Lavoro (Milan), 59(5):370-375, 1968.

Measurements conducted from 1958 to 1965 show that fluoride emissions from an aluminum factory near Bratislava ranged from 3.6 to 4.2 tons per day. In the zone surrounding the factory, the total concentration of fluoride in the air averaged 0.14 mg/cu m, five times the amount of the maximum allowable concentration. The gaseous fluorides HF and SiF4 constituted 39% of the total fluorides in this area, and the particulate fluorides CaF2, NaF, and AlF3 about 61%. At a distance of about 8 to 9 km, the gaseous forms were 85% of the total, and the particulates only 15%. Values up to 135 mg F/100 g were found in the soil near the factory. Grass in this area had a fluorine content as high as 135 mg/100 g dry weight. Drinking water in the area was relatively unaffected, but the pollution of marsh and stagnant waters averaged 10.9 mg/liter. The high environmental F concentrations were reflected in animals: ashes from the bones of sparrows and frogs caught near the factory contained, respectively, from 101.3 to 352.7 and 85.2 to 788 mg/100 g. The following measures are proposed to protect the health of the inhabitants of the region: limitations on the food products grown even in the least contaminated zones and on the number of persons allowed to settle in the area, clinical control of the exposed population, and a plan of development for the entire region. These measures should be implemented by technological steps to reduce the pollution caused by the factory.

27254

Kumamoto Prefectural Government (Japan), Public Nuisance Section

REPORT OF INVESTIGATION OF THE AIR AND NOISES. (V): JANUARY, 1969 - MARCH, 1970. (Taiki, soon chosa hokoku sho. Dai V ho. (Showa 44 nen 1 gatsu - Showa 45 nen 3 gatsu)). Text in Japanese. 212p., May 1970.

Investigations of air pollution, meteorology, and environmental pollution were carried out at Kumamoto, Arao, Udo, Yatsushiro, Taura-cho, and Minamata of Kumamoto Prefecture from January 1969 to March 1970; the results are reported. The average annual amounts of dust fall are within a 5.15 - 12.34 t/sq km/month level (by the deposit gauge method) and it is decreasing in all cities with every year. Among the contents of dust fall nitrate (-) was frequent in the cities where they use coal for fuel and sulfate (-2), chlorine (-), and calcium (+2) in the cities where there were carbide or chemical factories. Concentrations of sulfur dioxide (by the PbO2 method) are increasing in all cities; the highest value of the average annual concentrations was 0.94 mg/100 sq cm/day at Arao and the lowest was 0.23 mg/100 sq cm/day at Taura There was about 33% increase in general compared with those of the previous year. The results of automatic measurements of SO2 and floating dust at Arao and Yatsushiro revealed that the average annual values were 2.60 ppm at Arao and 0.86 ppm at Yatsushiro; the average annual index of the degree of pollution by floating dus was 12.5% and 4.29%, respectively. Measurement of concentration of fluorine in falling dust and in indicator plants has been carried out since June 1969 in order to perform examinations before the establishment of a factory for electrolysis of aluminum at Arao. Carbon monoxide, nitric oxide, nitrogen dioxide, and the amount of floating dust and its contents were measured in order to investigate the effects of automobile traffic volume and automobile exhaust gases.

33309

Lindberg, Walter

ATMOSPHERIC POLLUTION PROBLEMS IN NORWAY. National Society for Clean Air, London (England), Intern. Clean Air Conf. Proc., London, England, 1959, p. 21-22. 4 refs. (Oct. 20-23.)

In the past, air pollution in Norway was not a serious problem and only caused rare effects on human health, such as manganese pneumonias. Recently, air pollution from the aluminum industry has led to grass pollution with fluorides and resulting fluorosis in cattle. Public interest has led to the creation of a committee on air pollution to investigate prevention and to recommend abatement laws and regulations. Although air pollution in Norway is not as serious as in other countries, it is a considerable nuisance. The most serious problems are caused by the location of industry in deep valleys on the coast. A ust fall survey in Oslo showed 20 to 55 per cent of the average values found in London. The amount of dust and ash decreased in December and increased in April, when the snow melted, leaving the sand and gravel exposed. Since 1958, air pollution has been measured at 11 sites by smoke filters (reflectometer readings), volumetric sulfur dioxide apparatus (titration of total acidity following absorption in peroxide solution), and tarry matter fluorescence measurements. The pollution varied markedly in the winter due to high fuel consumption for domestic heating. Also, pollutants accumulated during the winter in calm weather and with inverse vertical temperature gradient. The use of hydroelectric power should reduce pollution.

37823

Voytov, V. T.

EVALUATION OF GASEOUS CONTAMINATION IN THE ELECTROLYSIS SHOPS OF THE BRATSK ALUMINUM PLANT. (Operativnaya otsenka zagazovannosti tsekha elektroliza na BrAZe). Text in Russian. Tsventn. Metal., no. 10:45-47, Oct. 1971.

The quality of the technological equipment was studied, and the contributions of human carelessness to air pollution were analyzed. Based on the weekly surveys of electrolyzers, burners, and exhaust fans, contribution indices were established for the different equipment and stages of technology. The number of non-hermetic electrolyzers was regularly determined. As a result of the steps taken, the number on non-hermetic electrolyzers dropped from 32.3% in Sept. 1969 to 15%

in Feb. 1970. General improvement in air quality was reached, with concentrations below the threshold. Hydrofluoric acid and fluoride concentrations of 0.27 mg/cu m and 0.42 mg/cu m, respectively, were measured in Feb. 1970, against the maximum allowable values of 0.8 mg/cu m and 1 mg/cu m. In addition, drastic drop in the volume of atmospheric emissions was obtained.

39182

Bourbon, P.

ANALYTICAL PROBLEMS POSED BY POLLUTION BY FLUORINE COMPOUNDS. (Probleme analytique du dosage de l ion fluor). Text in French. National Society for Clean Air, London (England), Intern. Clean Air Congr. Proc., London, England, 1966, p. 174-176. (Oct. 4-7, Paper VI/6.)

Analytical problems from fluoride pollution are discussed; a critical analysis of air sampling methods is made. Discussions are illustrated by determinations carried out at 20 sampling locations situated at a 20 km radius around an aluminum factory of one of the Pyrenean valleys in France. Sampling methods focus the utilization of an impinger which is a modification of the Greenberg-Smith device and which allows accumulation of fluorine ions 70 ml of 0.1 N sodium hydroxide solutions with no dust or hydrogen fluoride interference. Determinations of F ion were made monthly. Fluorine containing dusts were determined at a 1.0 km radius around the factory whereby separation from hydrogen fluoride was carried out with Millipore filters (0.8 micron pores). These filters were utilized when sampling was made in dry weather conditions and heated air flows (80 C) were bubbled into NaOH- containing impingers. The amounts of HF carried along did not exceed 5.0% of the total amount of fluorine thus trapped. Additional information was obtained from F ion determinations carried out on rain water samples at the 20 pluviometer network installed at a 10 km radius around the factory. Determinations made once monthly according to the Spanos-Zirconium method showed only the presence of ionisable fluorine in the rain water. Of the thoroughly described sample preparation and analytical methods the Lanthane-Alizarine-complexone specrophotometric procedure was the best one for below 10 micrograms F ion in 50 ml aliquots. Average values (from 100 samples) showed F ion from hf to be 57% and F ion from dust to constitute 47%. The dust composition included coke, tar, aluminum trioxide (50-60% of the dust weight), sodium carbonate and sodium sulfate (traces), and fluorine compounds. Fluorine pollution ranged from 0-3.0 micrograms/cu m referred to as F ion. Amounts below the 1.0 micrograms/cu m level were the most frequent. Extreme values of 10 - 20 micrograms/cu m were found incidentally in the immediate vicinity of the plant under inversions.

E. ATMOSPHERIC INTERACTION

15604

Bovay, E. and A. Bolay

DISPERSION OF FLUORINATED GASES IN THE CENTRAL VALLEY. (La dispersion des gaz fluores cans le Valais central). Text in French. Agr. Romande. Ser. A, 4(5):33-36, 1965.

The movement of air masses in the Rhone Valley, based on topography, have a considerable effect on the location and the amount of fluoride pollution from the aluminum plants in the area. A map of the Rhone Valley indicates that the area of greatest pollution seems to be on the south side of the valley near the town of Martigny. Fluoride levels were determined in plants at verying distances from the source of pollution. In general, plants in the Martigny area seemed to have the highest fluorine content; the highest fluorine samples were from trunks of poplar trees in the Martigny area. High levels were also recorded in pear trees, potatoes, and apricots in the same area.

16567

Martin, J. F. and F. Jacquard

INFLUENCE OF FACTORY SMOKE ON LICHEN DISTRIBUTION IN THE ROMANCHE VALLEY (ISERE). (Influence des fumees d'usines sur la distributi des lichens dans la vallee de la Romanche (Isere)). Text in French. Pollut. Atmos. (Paris), 10(38):95-99, April-June 1968. 15 refs.

Four manufacturing plants produce pollutants in the Romanche Valley, between Le Roure-d'Oisans and Vizille; one produces hydrogen fluoride and three produce particulate matter. The plant farthest down the valley produces calcium carbonate and gives off smoke, the solid matter of which consists of 50% calcium oxide and oxides of magnesium, silicon, iron, aluminum, and carbon. The second and fourth factories produce ferro-alloys and calcium carbonate and have similar pollutants. The third factory is an aluminum plant and produces fumes of hydrogen fluoride and other fluorides. Micrometeorological studies showed that the direction of the smoke was usually up-valley, with local and minor variations. The pH of the snow fall in the region of the factories averaged about 10, with values of 11.2 and 12.2 registered during February 1965 and December 1966. The pH of the rain averaged 10, and the pH of the bark of trees growing near the factories was also alkaline. Bark from similar trees near Grenoble had an acid pH. Rock surfaces in the area were covered with a gray-blue patina. Three zones of lichen growth were identified: poor growth of toxitolerant and coniophile lichens, up to approximately 500 meters from the factories; a transition zone; and a 'normal' zone, the boundaries of which varied within wide limits, but were approximately 1 km from the factory. Growth in the third zone corresponded to that in non-polluted areas. A list of lichen species identified is presented.

37639

Ivos, J., Hania Ciszek, A. Rezek, and Lj. Marjanovic

FLUORINE WASTE GASES IN THE SURROUNDING ATMOSPHERE OF YUGOSLAV FACTORIES. (Otpadni plinovi fluora u okolisnoj atmosferi nasih tvornica). Text in Serbo-Croatian. Vet. Arh., 40(3-4):61-77, 1970. 20 refs.

The dispersion of fluorides was investigated in three areas of Yugoslavia jeopardized by fluorosis: Kidricevo, Lozovac, and Razine. Fluorides were measured in both aluminum electrolysis rooms and the open atmosphere to determine the direction and extent of their dispersion. The annual average levels in the electrolysis rooms were 4.6 mg/cu m at Kidricevo; 5.6 mg/cu m at Lozovac; and 3.6 mg/cu m at Razine. In the Ptuj field (Kidricevo), the average annual amount of fluoride in precipitation was 0.4 mg/l at six locations representing various directions and distances from the source of contamination. The annual average amount of fluorides for all six locations was 1.04-0.14 mg/l. The fluoride-containing waste gases moved in the direction of prevailing winds to a definite distance, after which the concentrations decreased.

F. BASIC SCIENCE AND TECHNOLOGY

39861
Seligman, Richard
ALUMINIUM PRODUCTION BY ELECTROLYSIS: A NOTE ON THE MECHANISM OF THE REACTION. J. Inst. Metals, 17(1):141-144, 1917. 3 refs. (Presented at the Institute of Metals, Annual Meeting, London, England, March 21, 1917.)

The conventional formula for the production of aluminum by electrolysis of a fused mixture of cryolite and alumina is Al203 + 3C equals 3CO + Al2. Experiments in an electric furnace indicate that this formula, which assumes a carbon consumption very near to theoretical, is not correct. A carbon consumption well below the theoretical was attained and the fact that carbon monoxide is not necessarily the sole gaseous product of the reaction was demonstrated. Whether oxygen, carbon dioxide, or carbon monoxide result from the reaction depends on such factors as temperature, current density, physical properties of the anode, and the rapidity with which the gases are removed from contact with the anode.

G. EFFECTS-HUMAN HEALTH

06241

P. Macuch, G. Balazova, L. Bartosova, E. Hluchan, J. Ambrus, J. Janovicova, and V. Kirilcukova

HYGIENIC ANALYSIS OF THE INFLUENCE OF NOXIOUS FACTORS ON THE ENVIRONMENT AND STATE OF HEALTH OF THE POPULATION IN THE VICINITY OF AN ALUMINIUM PLANT. J. Hyg. Epidemiol. Microbiol. Immunol. (Prague) 7, 389-403 (1963).

The state of health of all children aged 6-14 years living for at least six years in the fall-out area of the aluminum works was studied. Special attention was paid in their history and in objective examination to the signs described in the literature as the manifestations of the action of fluorine compounds on the human organism, i.e. the haemoglobin percentage, the erythrocyte and leucocyte count and the differential white cell count. Fluoride excretion was controlled in a single urine sample collected over a period of four hours. Bone radiograms were made of the lumbar spine, together with the hip joint, and of the shoulder and arm, together with the elbow. In all the children the teeth were also examined. The average haemoglobin values among children in the given age group (6-14 years) in the fall-out area of the aluminium plant were significantly lower than in the controls. Average erythrocyte values were significantly higher. Average leucocyte values in children aged 6-8 in the fall-out area were higher than in the controls. In the higher age groups the situation was reversed. In the differential white cell count no significant differences were found between average granulocyte values. The significant difference between the amount of haemoglobin in children in the fall-out area of the aluminium plant and in the control group shows that the lower haemoglobin findings in the affected community could be attributed to the less favourable environmental conditions resulting from its proximity to the aluminium plant. The experiences and the individual results obtained from these analyses are used as a basis for suggestions for essential health measures in concrete situations and for the formulation of principles of preventive hygienic protection when projecting and selecting the site of large industrial plants.

10203T

Balazova, G., L. Balazovjechova, and V. Kirilcukova

DEPTH ANALYSIS OF THE HEALTH OF CHILDREN LIVING IN THE VICINITY OF ALUMINUM WORKS. (Hlbkovy rozbor zdravotneho stavu deti v sidlis- kac z okolia zavodu na vyrobu hlinika.) Translated from Slovak. Cesk. Hyg., 5(10):573-579, 1960. 20 refs.

Children living in a village in the vicinity of an aluminum plant and in a control village were examined for hemoglobin percentage, erythrocyte and leucocyte counts, differentiation of the blood coun amount of fluorides eliminated in urine, and general state of healt In the case of the children of the affected village radiographs we also taken of the bones, and the children's teeth were examined. I the affected village the average percentage of hemoglobin was 62.85 in the 6-8-year-old group and 69.55 in the 9-11-year-old group as compared to 70.95 and 72.25 respectively in the control village. T average erythrocyte count in children of the affected village was 3,958,000 in the 6-8-year- old group and 4,208,000 in the 9-11-year old group as compared to 3,741,000 and 3,783,000 respectively in th control village. No substantial differences were found in the valu of segmented and unsegmented neutrophiles, eosinophiles, basophiles and the lymphocyte and monocyte counts between children of the affected village and the control village. The average level of fluorides eliminated in urine was 0.91 mg/l in children of the affected village as compared to 0.48 mg/l in those of the control village. Evaluation of subjective complaints and objective symptom shows no perceptible differences between children of the affected village and those of the control village. Radiographs of bones for children of the affected village showed no changes which could be suggestive of pathological and significant fluorosis. The teeth of the children from the affected village also showed no traces of fluorisis as yet. (Authors' summary)

10333

M. C. Sadilova, K. P. Seliankina O. K. Shturkina

EXPERIMENTAL EVALUATION OF CONCENTRATIONS OF HYDROGEN FLUORIDE DETECTED IN THE AMBIENT AIR. ((Zksperimentalnaya otsenka kontsentratsii ftorictogo vodoroda, obnaruzhivaemkh v atmosfernom vozdukhe.)) Text in Russian. Vrachebnoe Delo No. 1:89-91, Jan. 1967. 4 refs.

The aluminum, cryolite, superphosphate and other industries which use fluorine compounds all emit NF, NaF, AIF3, and Na3AIF6 into the air. Air containing fluroine levels of 0.20, 0.10 or even 0.03 mg/cu m has a noxious effect, particularly on children, and raises their general susceptibility to illnesses, attacks their breathing system, and destroys tooth enamel. White male mice, two months old, were exposed to different levels of hydrogen fluoride around the clock for five months, except for a four-week recess. Concentrations of the 0.10, 0.03 and 0.01 mg/cu m level were administered to three groups of animals. The 0.10 concentration was found to produce a profound, generally toxic, effect. Less intense but still clearly defined, were damages caused by the 0.03 concentration. The 0.01 concentration had no detrimental effect. Data from these experiments are thought to be conclusive as to the dangers to children who reside within industrial pollution zones.

11482

Kyartovkina, L. K.,R. M. Kazanskaya,A. E. Kantemirova, A. S. Kryukov,N. P. Kuleva,E. A. Meerson, and O. I. Tarannikova

EFFECT OF DISCHARGES FROM AN ALUMINUM WORKS ON HEALTH OF CHILDREN. ((Vliyanie uybrosov alyuminievogo zavoda na zdorov'e detei.)) Hyg. Sanit. (English translation of: Gigiena i Sanit.), 33(4-6):106-108, April-June 1968. ((2)) refs. CFSTI: TT 68-50449/2

The population's living conditions and the state of health of the children living in settlements situated within a radius of 500 to 1,000 m from the aluminum works were studied. The population were questioned by means of a special standard questionnaire 3 times in three years. The inhabitants voiced numerous complaints about the impossibility of airing their

apartments and the obnoxious odor of the air which caused headaches, cough and nausea. An analysis of medical statistics revealed that the most common causes for the children's visits to the physicians were upper respiratory infections, bronchitis, pneumonia, laryngitis and tracheitis. The highest incidence of respiratory diseases occurred among the youngest children (up to 4 years old) who had been born and had always lived close to the aluminum works, being 11.2 times higher than in the control group. The incidence of respiratory diseases among the children aged 4-5, who were born 1 year before the opening of the aluminum works was 3.7 times higher than in the control group; it was 2.7 times higher at the age of 5-6; 2.2 times higher at the age of 6-8; 1.3 times higher at the age of 8-9; 1.8 times higher at the age of 9-10; 2.8 times higher at the age of 10-11; and double at the age of 11-12. There was a distinct relationship between the incidence of respiratory diseases and age. According to our findings, these discharges were most injurious in the youngest age group (up to 4 years). The effects of the industrial discharges from the aluminum works on the children's health were investigated among 113 creche children, 186 preschool children and 150 schoolchildren. Creche children residing in the settlement exposed to pollution displayed a statistically significant though not very large increase in their RBC (P less than 0.01). Hemoglobin concentrations were practically identical in summer, but in winter the level was significantly lower in the children exposed to the discharges (62 + or - 0.69 and 68.8 + or - 0.9). The WBC was practically the same in both groups at all seasons. The eosinophil counts were identical in summer but significantly higher in winter in the children exposed to pollution (P less than 0.02). Monocyte and lymphocyte counts as well as the ESR were practically the same in both groups. Various other findings are presented.

13215

Colombini, M., C. Mauri, R. Olivo, and G. Vivoli

EXPERIMENTS ON RABBITS FED FORAGE GROWN NEAR AN ALUMINUM FACTORY. Fluoride Quarterly, J. Intern. Soc. Fluoride Res., 2(1):49-54, Jan. 1969. 2 refs.

Skin lesions resembling bruises were exhibited by individuals living near an aluminum factory in Chizzola, Italy. To study the etiology and pathogenesis of this phenomenon, male albino rabbits were fed forage grown near the factory and forage artificially contaminated by substances collected from the factory's purification system. At regular intervals, serum alkaline phosphatase, serum calcium, serum phosphate, leucocyte alkaline phosphatase, and nonspecific esterases were determined. After about five months, the animals were killed and fragments of their tibia were analyzed for fluoride. The serum alkaline phosphatase, calcium, and phosphorous levels did not show any significant changes in the treated animals. A decrease in the leucocyte alkaline phosphatase activity of positive cells was observed. Nonspecific esterases were present in very small quantities in pseudo-eosinophils, in traces in lymphocytes, and in slightly greater amounts in monocytes. The fluoride content of the bones of treated rabbits was almost twice as high as that of control rabbits, who received forage from uncontaminated areas. (Author summary modified)

13700

Balazova, G., P. Macuch, and A. Rippel

EFFECTS OF FLUORINE EMISSIONS ON THE LIVING ORGANISM. Fluoride Quarterly, J. Intern. Soc. Fluoride Res., 2(1):33-36, Jan. 1969.

Health parameters were measured in children living in an area near an aluminum factory. In the area near the factory, excessively high F levels were found in the air and in dust. This fact was reflected in high F levels of agricultural products. High F levels were noted in urine, hair, nails, and teeth in the child population residing in the immediate vicinity of the factory. In children living in the exposed area since birth, hemoglobin values were lower and erythrocyte values were higher than in a control area. The average daily total F intake was calculated at 2.15 mg for the exposed children as compared with about 1 mg in the controls. (Author summary modified)

13837

Steinegger, S.

ENDEMIC SKIN LESIONS NEAR AN ALUMINUM FACTORY. Fluoride Quarterly, J. Intern. Soc. Fluoride Res., 2(1):37-39, Jan. 1969. 6 refs.

Numerous cases of endemic skin lesions were encountered in children living near Chizzola, Italy, and were attributed to air pollution from a neighboring aluminum factory. The lesions, consisting of grayish-brown to blue patches 1 to 2 cm in diameter, are fleeting in character. After they fade, new ones appear on other parts of the body. None can be identified historically with any trauma. All are readily differentiated from suffusion because their bluish color does not gradually change to yellow during the healing stage. Between June 20 and September 1967, 72 cases were encountered in kindergarten pupils. They occur less frequently in women. Up to September 1967, none had been encountered in men. When the children were temporarily removed from the area, the lesions cleared up promptly. Endemically, the lesions are confined to the area where farmers have reported damage to livestock and vegetation. This suggests that fumes or particulate matter emanating from the aluminum factory are responsible for the condition.

14112

Balazova, G. and A. Rippel

A STUDY OF THE HEALTH CONDITIONS OF THE PEOPLE LIVING AROUND AN ALUMINUM FACTORY. (Studio sulle condizioni di salute della popolazione abitante nelle vicinanze di una fabrica di alluminio). Text in Italian. Med. Lavoro (Milan), 59(5):376-380, 1968. 4 refs.

The physical condition of children living in the area of an aluminum factory was studied. Ambient air around the factory was heavily polluted by fluorine and high concentrations of fluorine were present in the agricultural products of the region. In the children examined, absorption of fluorine by digestive and respiratory systems was approximately 2.15 mg/day. In contrast to children living considerable distances from the factory, these children showed marked increases in the fluorine content of their teeth, nails, hair, and urine. Clinical and laboratory studies indicated a moderate decrease of hemoglobin values and a slight increase of red blood cells among the affected children.

14319

Cavagna, G., G. Locati, and L. Ambrosi

EXPERIMENTAL STUDIES IN NEWBORN RATS AND MICE ON THE SUPPOSED CAPILLARY-DAMAGING EFFECTS OF FLUORINE AND FLUORINE-CONTAINING INDUSTRIAL POLLUTANTS. Med. Lavoro (Milan), 60(4):267-273, 1969. 12 refs.

Bluish skin-spots occurring in women and children living in the vicinity of a fluorine-emitting aluminum factory have been attributed to a poorly understood capillary-damaging effect of fluorine. To clarify this phenomenon, a study was carried out

on rats born of mothers which were injected subcutaneously for the whole pregnancy period with NaF and an extract of dust emitted from the aluminum factory at a dose of 2 mg fluorine per day. The total dose of fluorine given was 40-52 mg. No cutaneous lesions, or even an increased capillary fragility of the skin, as proved with the suction cup test were observed. In a second experiment, newborn rats were injected subcutaneously with NaF and the dust extract at a dose of 0.2 mg fluorine per day in the first 10 days of life. Again no cutaneous lesions or increased capillary fragility of the skin were observed. Studies on subacute toxicity were carried out in female mice injected subcutaneously with NaF and with the dust extract in a dose of 0.2 mg fluorine per day for 24 days. No cutaneous lesions or capillary alterations as studied in histologic preparations of the mesentery were observed. (Author summary modified)

17642

Tomson, N. M., Z. V. Dubrovina, and E. N. Bondareva

SANITIZATION OF ATMOSPHERIC AIR POLLUTED BY AN ALUMINUM PLANT DISCHARGES. U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, vol. 8:136-140, 1963. (B. S. Levine, ed.) CFSTI: 63-11570

Air in the vicinity of a plant where aluminum oxide is electrolyzed on carbon electrodes was analyzed for dust content, fluorides, sulfur dioxide, and tars. Dust settling at 500 meters from the plant accumulated to 63 g/sq m in 30 days; at 1000 meters, to 200 g/sq m; and at 2000 meters, to 50 g/sq m. Sulfur dioxide concentrations of 6.0 mg/cu m in the plant's sanitary clearance zone were 12 times in excess of the 0.03 mg/cu m allowable limit and hydrogen fluorides were 68 times in excess of the allowable 0.3 mg/cu m limit. At 2000 meters, the concentration of tarry substances was 100-200 mg/cu m. In neighboring residences, sulfur dioxide concentrations were almost identical with those outdoors, while fluoride concentrations were even greater. Forty-one percent of the patients from the village where the plant was located had active tuberculosis or were carriers of tubercule bacilli. It is proposed that the pollutant discharge be reduced by the use of tall stacks, fluoride trapping devices, and more suitable electrodes.

19215

Tsunoda, Humio

THE INFLUENCE OF AIR POLLUTION BY FLUORIDE ON THE HUMAN HEALTH. (PART 1). (Fukkabutsu niyoru taikiosen to ningen no kenko (sono 1)). Text in Japanese. Kogai To Taisaku (J. Pollution Control), 6(7):504-508, July 15, 1970.

Air pollution by fluorides has two main aspects: the fluorides are extremely toxic for plants, parts per billion being critical for most plants, and the fluorides are accumulated in plants. Livestock feeding on them develop chronic fluorosis. To survey the air and environmental pollution caused by fluorides around the large aluminum plant in Fukushima Prefecture, a high volume air sampler was used. Within 1 km from the factory, 5.2-14.0 mg of fluorine per 1 cu m air was observed. Secondly, a relative measurement by lime treated filter paper technique was employed. The fluorine concentration in the factory was 100 times that of the adjacent villages. A method of airborne particulates was used to monitor the fluorine concentration. In the factory premises, the particulate concentration was 20 times as dense as that in villages. The fluoride pollution of the soil and subterranean water was also monitored. Among vegetables and cereals cropped in the area, some of the green vegetables showed 10 times more fluoride content than in plants from other areas. The inhabitants of the area take in 4.2 mg fluorine daily, which is above the daily limit of 3.5 mg of an average Japanese. After the physical check-up of the inhabitants, dental fluorosis, skeletal fluorosis, and crippling fluorosis were found.

19880

Balazova, G. and A. Rippel

A STUDY OF HEALTH CONDITIONS OF THE POPULATION LIVING IN THE VICINITY OF AN ALUMINUM FACTORY. (Studio sulle condizioni di salute della popolazione abitante nelle vicinanze di una fabbrica di alluminio). Med. Lavoro (Milan), 59(5):376-380, 1968. 4 refs. Translated from Italian. Belov and Associates, Denver, Colo., 6p., Jan. 27, 1970.

The health conditions of children living near an aluminum factory were studied. The ambient pollution from fluorine emitted by the factory was very high. High fluorine values were found in the agricultural products of the areas near the factory. In the children examined, the absorption of fluorine by the digestive and respiratory systems was approximately 2.15 mg/day. The children showed a marked increase in the fluorine content in their teeth, hair, nails, and urine when compared with children living in a non-polluted area. Clinical and laboratory studies revealed a moderate decrease in hemoglobin values and an increase in the red blood cell count in children exposed to a high absorption of fluorine. When some of the children were transferred to a non-polluted zone, the urinary excretion of fluorine decreased by 40% after one month. It may, therefore, be assumed that the accumulation of fluorine is reversible. (Author summary modified)

23003

Tsunoda, Fumio

THE INFLUENCE OF AIR POLLUTION BY FLUORIDE ON HUMAN HEALTH. (Fukkabutsu ni yoru taiki osen to ningen no kenko). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 6(8):577-582, Aug. 15, 1970. 25 refs.

The health condition of employees under the influence of atmospheri fluoride in an aluminum refinery and the health condition of neighboring residents under the influence of contaminated air from the refinery were surveyed from the viewpoint of epidemiology and clinical toxicology. The people living in the fluoride-bearing atmosphere did not have clear subjective symtoms as to skin and mucous troubles when the fluoride level was between 1.0 and 1.9 ppm. This is quite contrary to the effects of other stimulative gaseous substances like SO2 which is particularly irritating to olfactory organs and skin. Fluoride concentration between 1.0 and 1.9 ppm may cause light obstructive trouble to the pulmonary function but not seriously. The investigation of atmospheric Ht variation and of both tooth spot trouble and osteomalacia, which are representative of chronic fluoride poisoning, has indicated that daily exposure to fluoride-bearing air did not provide any conclusive evidence as to its effect on health as long as the concentration remains between 1.0 and 1.9 ppm. Some dubious aspect in view of clinical toxiology are presented, however. As in the case of the influence of excessive fluoride intake through agricultural products, the direct effect of atmospheric fluoride on respiratory organs is a subject still to be studied.

26136

Tauda, F.

PRESENT SITUATION AND OUTLOOK OF FLUORIDES AIR POLLUTION PREVENTION TECHNOLOGY--TACK-

LING WITH ALUMINUM SMELTING POLLUTION. (Fukkabutsu ni yoru taiki osen boshi gijutsu no genjo to tenbo - arumi seiren kogai ni torikumu). Text in Japanese. Kinzoku (Metals) (Tokyo), 41(1):122-125, Jan. 1 and 15, 1971. 9 refs.

Sources of fluoride pollution and the effects of fluorides on man and plants are reviewed. Aluminum electrolysis uses cryolite which is 54% fluoride. Raw materials containing fluorides are also used in the production of phosphate fertilizers and iron and steel. Raw materials containing smaller amounts of fluorides are required for the production of glass fibers, bricks, tiles, cement, and porcelain. Coal burned by thermal power stations can be a problem since coals contain 20-295 ppm of fluorides, averaging 120 ppm. Fluorides affect plants more than any other atmospheric pollutant, accumulating in a large number of species in polluted areas. Fluorides affect man in two ways, directly through air pollution or indirectly through contaminated vegetation. They are present in considerable amounts in both green vegetables and rice. Symptoms of chronic fluoride poisoning in man are abnormal hardening of bones and spots on teeth. Cases of chronic poisoning have appeared among workers exposed to cryolite dust and among individuals whose drinking water contains more than 6 ppm fluorides Existing technology, the use of scrubbers for controlling fluoride emissions from aluminum electrolysis or electric furnaces, is effective only with concentrations up to 1 ppm. New production technologies should be developed which dispense with the use of raw materials containing fluorides.

26846

Tsunoda, Fumio

NEW ASPECTS OF AIR POLLUTION PROBLEMS: SPECIAL REFERENCE TO FLUORIDES. (Taiki osen mondai no arata naicn: kyokumen - fukkabutsu ni yoru baai o rei ni). Text in Japanese. Igaku No Ayumi (Progr. Med.), 70(13):621-623, Sept. 1969. 2 refs.

Fluorine in air pollution mainly originates from aluminum refineries, phosphate fertilizer factories, and ceramic industries. Fluorides have a strong toxicity against plants and tend to become accumulated in them. For example, in the western mountain areas of Fukushima Prefecture, silk production has been destroyed due to damages to mulberry trees since the establishment of an aluminum refinery plant in the area. The process involves the use of 3NaF-AlF3. An epidemiological investigation was conducted on pollution by fluorides, and the subjects chosen for this purpose were 35 to 54- year old farm workers exposed for a long time to hig concentrations of fluorides in air. The items examined were the determination of fluorine in urine, pulmonary function, existence of effects on teeth, and hardening of bones. Although it will take a long time to get any results from the investigation, it is also necessary to evaluate the effects of fluoride pollution in water, soil, and food.

28754

Tsuji, Yoshihito and H. Tsunoda

AN EPIDEMIOLOGICAL SURVEY ON THE HUMAN EFFECTS OF FLUORIDE AIR POLLUTION IN KITAKATA, FUKUSHIMA PREF. IN JAPAN. (Fukkabutsu ni yoru taiki osen no seitai ni oyobosu eikyo ni tsuite no ekigaku chosa. Kitakata-shi no baai). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 5(1): 145, 1970. (Proceedings of the Japan Society of Air Pollution, Annual Meeting, 11th, 1970.)

An epidemiological study was conducted on the relationship between contamination of air by fluorides emitted from an aluminum refining factory and the health of adults permanently residing in the area. The subjects were residents, aged 35-64 yrs, in the polluted village and of a control village. Subjective symptoms of fluoride poisoning, bone x-rays, cardiac and pulmonary functions, blood characteristics, and fluoride content of urine were studied. 'Discomfort' was obviously more frequent among men and women of the polluted area, but there was little difference between the two villages with respect to irritation of skin and eyes and pain in the joints. Results of pulmonary and cardiac function tests were also similar. Bone x-rays showed that osteosclerosis was relatively more frequent in the polluted area only for knee joints. As far as blood characteristics were concerned, there were no abnormal findings in either village. Urine fluoride levels were higher among men in the polluted area, but the concentrations were ion concentrations and the measurements were made only over a short period. Thus no conclusive statements could be made as to the effects of fluorine on the urine of the residents.

31319

Schlipkoeter, H. W. and R. Dolgner

HEALTH PERILS DUE TO AIR POLLUTION. (Gesundheitsgefaehrdung durch Verunreinigung der Luft). Text in German. Atomwirtschaft, 16(6):288-293, June 1971. (Presented at the Reaktortagung Kerntechnischen Gesellschaft im Deutschen atomforum, Bonn, West Germany, March 30-April 2, 1971.)

Health risks through air pollution are discussed by means of specific examples. Emissions emanating from large industries are of limited importance only, since they effect merely the closer vicinity of the source of emission. Furthermore, the typical composition of pollutants is known for each of these industries, and their health risks can be evaluated and combatted individually. More reason for concern are emissions originating ubiquitously from all processes of incineration. Domestic heating, atuomobile engines, and a multiplicity of smaller industries produce a variety of air pollutants such as carbon monoxide, soot, polycyclic hydrocarbons, sulfur dioxide, lead compounds, and gaseous hydrochloric acid which arises in the incineration of polyvinyl compounds. Lead from automobile exhausts and fluorine compounds from aluminum works can be absorbed by food plants, and thus indirectly cause damage to the human organism. Sulfur dioxide and some hydrocarbons can attack the human respiratory tract and the lung. Dust in the air absorbs part of the ultraviolet radiation from the sun which is vital for some biological functions, for instance, the body development of children. Rickets, and affliction of the growing bone structure, and retardation in the growth of children can be ascribed to a lack of ultraviolet radiation. Carbon monoxide, when inhaled, combines with the hemoglobin of the blood to which it has a 200 time greater affinity than oxygen, and thus impedes the function of the blood in transporting oxygen.

33766

Leloczky, Maria

STUDIES ON THE HEALTH-DAMAGING EFFECT OF THE FLUORINE-POLLUTION OF THE AIR AROUND AN ALUMINUM FACTORY. (A levego fluorszennyezodesenek egeszseguyi hatasa az Inotai Aluminumkoho kornyeken vegzett vizsgalatok alapjain). Text in Hungarian. Egeszsegtudomany, vol. 15:74-80, July 1971. 21 refs.

Children in the housing estate Varpalota-Inota were examined for the effects of fluorine pollution from a nearby aluminum foundry. The presence of fluorine in the urine of the children was demonstrated, in some cases at a level usually found in the urine of the foundry workers. In a fluorine-free control

area, no fluorine could be demonstrated in urine from children. The hemoglobin level of the children at risk was low. A causal relationship between these findings and the fluorine pollution of air cannot be established because fluorine is only one of the air pollutions around Varpalota-Inota. Further investigations are in progress. (Author abstract modified)

37282

Steinegger, S.

HISTOLOGY OF CHIZZOLA MUCULAE. Fluoride, 5(1):14-17, Jan. 1972. 4 refs.

In recent years, skin lesions resembling traumatic suffusions have occurred in epidemic proportion in two Italian cities located near aluminum and other fluoride-emitting factories: Chizzola and Bolzano. Morphologically, the lesions are round or oval in shape. They have reddish-brown color when they originate but change to a bluish-brown prior to their disappearance. As determined by skin biopsies on three children with characteristic maculae, pericapillar lymphocytic infiltration and proliferation of endothelial cells of capillaries are the principle pathological features of the lesions. These features suggest a toxic inflammatory process.

37569

Balazova, G.

LONG TERM EFFECT OF FLUORIDE EMISSION UPON CHILDREN. Fluoride, 4(2):85-88, April 1971. 4 refs. (Presented at the International Society of Fluoride Research Conference, Annual, 3rd, Vienna, Austria, March 22-25, 1970.)

Five years after an aluminum smelter began operation, an 8-year study was initiated of the health status of 6- to 14-year-old children living in close proximity to the smelter. In the study area, the daily fluoride intake averaged 1.4 mg from food, 0.4-0.7 mg from air, and 0.1-31 mg/l from water. In a control area, the daily F(-) intake from food was 0.8 mg, and that from air was negligible. No evidence of skeletal fluorosis was found in the exposed children. Nevertheless, the average hemoglobin decreased and the F(-) content of teeth, nails, hair, and urine increased in the children. In teeth, fluoride levels averaged 45.02 mg/100 g (450 ppm) of the original weight compared to 15.71 mg in controls. Nail fluoride levels were 20.9 mg/100 g (209 ppm) for the exposed children versus 14.3 mg/100 g (143 ppm) for the controls. The F(-) content of hair in the affected area averaged 1.6 mg/100 g (16 ppm) compared to 0.75 mg/100 g (7.5 ppm) in the control area. Urinary fluoride values were 0.8 ppm and 0.4 ppm, respectively for the exposed children and the controls. In the smelter area, the urinary excretion of F(-) was lower in the 12-14 age group than in children aged 6-11.

37684

Balazova, G.

THE EFFECTS OF A PROLONGED INDUSTRIAL ATMOSPHERIC POLLUTION FROM FLUORINE ON CHILDREN S ORGANISM. (Der langfristige Einfluss von Fluoremissionen auf den Kinderorganismus). Text in German. Med. Lavoro (Milan), 62(4):202-207, April, 1971. 11 refs.

The effect of fluorinye emissions from an aluminum factory on the health of children living near the plant was investigated after 8 yrs of plant operation. The absorption of fluorine through food and in the air was examined. The theoretical daily intake of fluorine should be 1.4 mg food and 0.4-0.7 mg from air; in the control zone, the absorption in food was 0.9 mg/day and was practically insignificant in air. The fluorine content of drinkable water in both the control and exposed areas was 0.1-0.3 mg/l. Although no signs of fluorosis detected, the fluorine content of teeth, nails, hair and urine of the children exposed to plant emissions was higher than that of controls. The average values for the exposed and control groups, respectively, were 45.02 and 15.7 mg/100 g in the teeth; 20.9 and 14.3 mg/100 g in the nails; 1.6 and 0.7 mg/100 g in the hair; and 0.8 and 0.4 mg/l in the urine.

38942

Tsunoda, Fumio, Hiroko Kunida, and Kazuo Sasaki

A STUDY ON THE EFFECTS OF AIR POLLUTION DUE TO FLUORIDES ON HUMANS IN THE VICINITY OF MANUFACTURING FACTORY (1). (Arumi kojo shuhen ni okeru fukkabutsu ni yoru taikiosen no seitai ni oyobosu eikyo ni kansuru chosa kenkyu (1)). Text in Japanese. Kankyo Hoken Reporto (Environ. Health Rept.), no 8:41-51 Jan. 1972.

Effects of fluorides on human and the results of epidemiological studies carried out in Japan, were described. Schoolchildren living near an aluminum factory in Japan were tested as to subjective symptoms, mottled teeth, lung ventilation, x-ray examination of the bones, and fluorine concentration in urine. The incidence of malaise was remarkably higher in schoolchildren from a polluted area. Many schoolchildren of the polluted area showed mottled teeth and osteosclerosis of the knee joint. The amount of fluorine taken into body/day was investigated in fifty 30-60-year-old residents living around the same factory. A farming area within 500 m under the lee of the main wind was determined as a polluted area, and the other farming area over 6 km from the factory was determined as the control. Investigated items were staple foods intake and fluorine intake from them, fluorine intake from subsidiary foods, fluorine intake from drinking water, and excretion of fluorine in urine. Intake of fluorine from staple foods was significantly higher in residents of the polluted area, and its mean value was 2.89 ppm, 40% higher than that of the control. Fluorine taken from the air and the water by residents of the polluted area was suspected to be 0.1 mg higher/day than that by residents of the control area. Fluorine in urine was higher in residents of the polluted area, but the relationship between the intake and excretion of fluorine was not clarified.

39799

Cristiani, H. and R. Gautier

EXPERIMENTAL FLUORINE CACHEXIA: CHRONIC ACTION OF SODIUM FLUOROSILICATE IN SMALL DOSES. (La cachexie fluorique experimentale: effets chroniques de petites doses de fluosilicate de soude). Text in French. Compt. Rend. Soc. Biol. (Paris), 1925:946-948, 1925.

The chronic action of small doses of sodium fluorosilicate was studied on two groups of guinea pigs. The feed was powdered with two different doses of fine sodium fluorosilicate, in both cases. In the first group of 13 animals, treated with doses of 2 g, deaths occured, on an average, 35 days after the experiment started, with maximum and minimum of 64 and 9 days, respectively. The same symptoms were observed in all animals (loss of weight, cachexia, bulbous lesions). Special symptoms occurred a few days before death in some cases (stiffening of the spinal column, respiration troubles, tremors, and convulsions). The second group of 10 animals was exposed to 1/10 of the above dose. Death occurred, on an average, after 149 days, the maximum and minimum being 553 and 41 days. The cachexia was preceded by loss of weight. Similar symptoms and results were obtained with fluorine contaminated feed collected near aluminum plants.

40527

Tsunoda, Fumio

FLUORIDES AS AIR POLLUTANTS. PREVENTIVE TECHNOLOGY. POLLUTION IN ALUMINUM METALLURGY. (Fukkabutsu ni yoru taiki osen boshi gijuts no genjo to tenbo). Text in Japanese. Kinzoku (Metals) (Tokyo), 41(1):122-125, Jan. 1971. 9 refs.

Fluorine in the air easily reacts to dust, soot, and other inorganic matter. It is easily adsorbed by flue gas and reacts to vapor in the air to form hydrogen fluoride. Even the smallest amount of fluorides give a considerable damage to plants such as pine, iris, and gladioli. Furthermore, fluorides are accumulated in the plant leaves in polluted areas, and cause chronic fluoride poisoning of silkworms, cattle, and other animals that feed on such plants. The effects of fluorides in the air to human health is not severe if the content is on the order of the present 0.75 mg. However, fluoride can accumulate by consumption of agricultural produce grown in the areas that are polluted. There is a considerable amount of fluoride in rice and vegetables. Accumulation of fluoride taken over along period of time can cause chronic poisoning such as streaked teeth or hardening of bones. In the past, mass poisoning occurred in the area where natural ground water contained more than 1 ppm of fluorine or in crystal mines. Streaked teeth appear only when a child takes in a large dosage of fluorine daily between his infancy and 8 years old. Taking the same dosage after maturation does not cause streaked teeth. However hardening of bones will occur. Various methods of treating fluoride containing gas are reviewed. Spray tower, venturi scrubber, water jet scrubber, packed tower, and floating bed scrubber are compared. The most efficient are venturi scrubber and floating bed scrubber; but the operation is extremely costly.

40635

Cavagna G, and G. Bobbio

CHEMICAL AND PHYSICAL CHARACTERISTICS AND BIOLOGICAL EFFECTS OF EFFLUENTS FROM AN ALUMINUM PLANT. (Contributo allo studio delle charatteristiche chimico-fisiche e degli effetti biologici degli effluenti di una fabbrica di alluminio). Text in Italian. Med. Lavoro (Milan), 61(2):69-101, Feb. 1970.

In 1932, three years after the Mori aluminum plant at Chizzola in the Italian province of Trento went into operation, school children observed round skin spots of a bluish color. By 1937, 786 such cases (the vast majority were children and women) were examined at the local clinic. No symptoms of fluorosis nor an elevated fluorine level in urine were observed. Bioptic examination of the cutaneous lesions revealed a great variety of different manifestations among them congestion of the deep dermo-hypodermic blood vessels, perivasal edema, and diapedesis of neutrophile granulocytes. After 1937, the phenomenon disappeared only to reappear again in July 1965. At Ziar and Hronom in Czechoslovakia another eluminum plant emitting times the amount of fluorine did not produce this phenomenon, even though fluorosis there was frequent. Also the Rheinfelden aluminum plant in Germany whose fluorine emission is 23 times that of the Mori plant did not produce the above phenomenon. To relate the appearance of the skin spots to fluorine emissions, dust from the Mori electrofilter was fed and injected subcutaneously to rats, mice, guinea pigs, and rabbits and the biological effects were studied by examining their capillary fragility. None of the anatomical, pathological, and biochemical parameters determined showed any difference between experimental and control animals. Thus, in the absence of any other explanation the phenomenon must be ascribed to the toxic or toxic-allergic effect of hydrofluoric acid and fluorides. Chemical analysis of the dust disclosed the presence of many elements in trace quantities, none of which could be relevant to the phenomenon.

H. EFFECTS-PLANTS AND LIVESTOCK

04368

H. Schnitt and E. Moser

FURTHER DEVELOPMENTS OF THE FLUORINE PROBLEM IN THE ALUMINUM INDUSTRY. Weitere Entwicklungen zum Fluorproblem in der Aluminium-Industrie. Z. Erzbergbau Metallhuettenwesen 18, (3) 111-5, Mar. 1965. Ger.

This paper reports on the state of the arts concerning control and scrubbing equipment for fluoride inside working premises as well as directly from electrolytic furnaces. Far reaching research has improved the already very effective methods and installations. An optimal aerodynamic air ventilation is used very effectively. Control of dust and gaseous components, measurements of fluorine from the air inside of working premises and from the exhaust are done separately. Measurement and control is accomplished according to VDI-Richtlinien (guides) No. 2093 and 2452. The success of reduction in fluorine content with the installation of control equipment can be measured by the reduction of the fluoride content in grass, in the vicinity of the plant, which is used as cattle feed.

05871

K. T. Semrau

EMISSION OF FLUORIDES FROM INDUSTRIAL PROCESSES - A REVIEW. J. Air Pollution Control Assoc. 8, (2) 92-108, Aug. 1958. (Presented at the 130th Meeting, American Chemical Society, Atlantic City, N.J., Sept. 1956.)

Fluorine contaminants may be emitted to the atmosphere by a wide variety of industrial processes in which fluorine compounds are manufactured, utilized as catalysts or fluxes, or are present as impurities in the process materials. In some cases, the possibility of contamination is obvious, and control measures are generally provided as a matter of course. These include manufacture of HF, use of HF as an alkylation catalyst in the manufacture of motor fuels, and use of elemental fluorine. However, some of the most serious cases of pollution have arisen from processes in which fluorine compounds are used as fluxes or are present as impurities. In some instances, the fluorine has been present in the process material in a concentration so low that its presence was not considered to constitute a potential problem, or perhaps was not even recognized. Fluorosis in cattle, or damage to vegetation, ahs occurred primarily in the vicinity of plants manufacturing phosphate fertilizers, aluminum, brick, enamel frit, and iron and steel. MacIntire considers that the most important sources are probably the manufacture of phosphate fertilizers, aluminum, and steel. Thermodynamic considerations and a review of the literature indicate that the principal mechanism of liberation of fluorides in high temperature processes is pyrohydrolysis, which results in formation of HF. The principal variables in pyrohydrolysis in most industrial processes appear to be the equilibrium of the reaction, the water vapor concentration in the process atmosphere, and the factors determining mass transfer. Reaction rates appear to be generally high, although little information is available. Significant formation of SiF4 appears to be limited to cases involving thermal decomposition of fluosilicates or reaction of fluorides and silica with acids at relatively low temperatures. Formation of volatile metal fluorides may be a significant mechanism of liberation in some cases, but is generally of less importance than pyrohydrolysis. By analogy to known cases, it should be possible to make order-of-magnitude estimates of the probable fluorine emissions from a given process if the quantity of input fluorine is known or can be estimated.

09553

Crampton, E. W.

HUSBANDRY VERSUS FLUORIDE INGESTION AS FACTORS IN UNSATISFACTORY DAIRY COW PERFORMANCE. J. Air Pollution Control Assoc., 18 (4):229-234, April 1968. 7 refs.

During 1965 and 1966 a critical study was made of the quality, condition, and performance of some 1000 dairy cows on 45 farms in four compass areas in the region centering on Arvida, Quebec, where an Aluminum Smelting operation emits effluent that results in a contamination of their forage of from about 10 to as high at times of 105 ppm fluoride. Cattle winter forage in this area is consistently poor in quality, partly because of the species that can be grown, but more importantly because of adverse spring climatic conditions which in many year prevent harvest of hay until the plants have fully matured and ripened. Its effective feeding value, measured by recorded voluntary consumption and in vivo digestibility, has been found to be about half that of high quality legume hay. Commercially prepared meal mixtures constitute the non -roughage portion of the winter rations fed, and these by analysis have been found individually to contain from 65 to 85 ppm fluoride contributed chiefly, and probably exclusively, by some form of rock phosphate included as a source of the necessary phosphorus supplement. The factors statistically examined in the study included: growthiness, size, fleshing, and milking cows; the incidence and degree of dental fluorosis, and skeleton accumulation of fluoride (by tail bone biopsy of 48 representative cows); the makeup and amounts of ration fed daily during the winter farm feeding; and the feeding and breeding management followed. The statistical procedures of variance and covariance, and of correlation and partial regression were computer analyzed. The results indicated that inadequacy of energy intake traceable largely to the nutritional nature of the hay fed was of significantly greater importance than any of the other factors recorded. Fluorine ingestion carried a statistical weight of only about 3 percent as a cause of the performance of the cattle. By difference it appeared that breeding and the generally unsatisfactory management of the cows, especially the feeding practice, was about twice as important as feed allowances as causes of the poor quality and performance of the cows. (The terms fluorine and fluorine and the symbol F are used interchangeably in this paper. Levels of fluorine are reported on the elemental basis.) (Author's abstract)

13203

Lezovic, Jan

THE INFLUENCE OF FLUORINE COMPOUNDS ON THE BIOLOGICAL LIFE NEAR AN ALUMINUM FACTORY. Fluoride Quarterly, J. Intern. Soc. Fluoride Res., 2(1):25-27, Jan. 1969.

Quantitative and qualitative analyses of tissues, milk, and teeth, along with fluoride level determination of bones, show that animal and vegetable life near an aluminum factory is adversely affected by fluoride emissions. The factory is located in a mountain valley, within 300 meters of the nearest village. All trees examined showed a marked increase in the fluoride levels of their leaves or needles. The leaves of exposed fruit trees were harder, glossier, more fragile than normal, and covered with a whitish-gray crust. Similar changes occurred on leaves of garden vegetables, especially cabbage, turnips, and cucumbers. Fruit on trees was visibly deformed. The first signs of damage to animal life occurred two years after the factory went into operation, when about 95% of the goats and cattle were afflicted with fluorosis. Swine, horses, and poultry were less sensitive. The weight of the affected cattle gradually decreased to the point of cachexia. Calcium and phosphorous levels in the blood of the diseased animals averaged, respectively, 7.5 and 5.06 mg%. As an indicator of damage, fluoride deposits on snow were of the order of magnitude of 15 to 234.8 mg/sq m.

13838

Macuch, P., E. Hluchan, J. Mayer, and E. Able

AIR POLLUTION BY FLUORIDE COMPOUNDS NEAR AN ALUMINUM FACTORY. Fluoride Quarterly, J. Intern. Soc. Fluoride Res., 2(1):28-32, Jan. 1969.

From 1958 to 1965, contamination near an aluminum factory in the vicinity of Bratislava, Czechoslovakia, averaged 0.14 mg F/cu cm. This average represents a fivefold increase above the maximum allowable concentration of 0.03 mg F/cu cm. The gaseous fluorides HF and SiF4 constitute 39% of the fluid values in the air near the plant as compared to 61% solids, namely CaF2, NaF, and AlF3. The proportion varies with the distance from the factory: at an area 8 to 9 km from the factory, 15% solid and 85% gaseous F compounds were present in the atmosphere. The relative increase in gaseous compounds is apparently due to sedimentation of the solid F compounds near the factory. Values of the yearly F fallout in the contaminated area were 44 to 7337 kg sq km. F values obtained for soil in the area of the factory were 135 mg/100 g (1350). This is 4 to 7 times higher than the usual F content of soil. Grass near the factory contained F values as high as 133 mg/100 g dry substances. While running surface waters showed only slightly increased F levels, standing surface waters contained as much as 10.9 mg/l. Determination of F fallout and of F content in plants and biological materials is the best means of assessing long term effects of fluoride emissions. Meteorological influences appear to be less significant in evaluating F damage. The composition of soil, the presence of F dust on plants, and the F content of flowing and ground waters are of little use in determining F damage to human, plant, and animal life.

14678

Hadjuk, Juraj

REACTION OF SOME RELATIVELY RESISTANT PLANTS TO SUDDEN INCREASE IN THE CONCENTRATION OF FLUORINE EXHALATIONS. (Reakcia niektorych relativne rezistentnych rastlin na narazove zvysenie koncentracie fluorovych exhalacnych splodin v okoli hlinikarne). Text in Slovakian. Biologia, 21(6):421-427, 1966. 19 refs.

Since 1961, annual studies have been conducted to determine the effect of fluorine emissions from an aluminum factory in the Hron valley, central Slovakia, on local vegetation. The checkered pattern of phytopathological symptoms observable on individual plants is the result of irregular diffusion and dispersion of pollutants, unequal intake of nutrients, and unequal physiological processes taking place in different parts of a plant. Different degrees of resistance to pollution encountered among plants of the same species are explained by plant location. In June 1964, large necrotic markings appeared on plant leaves, and the growth of plants relatively resistant to fluorine was inhibited. The spontaneous appearance of necrosis might have been provoked by a gradual accumulation of fluorine in the soil surrounding plant roots, finally reaching toxic levels, or by a sudden increase in fluorine concentrations emitted to both air and soil. The period of spontaneous necrosis was found to coincide with a period when, because of technical adjustments, factory emissions of fluorine were double the average of previous years. It is concluded that plants can serve as indicators of increased fluorine emissions resulting from modifications of electrolytic installations or breakdowns in operating procedures. (Author abstract modified)

18269

Trautwein, K., and Ch. Kopp

EFFECTS OF FLUORINE ON CATTLE UNDER EXPERIMENTAL AND PRACTICAL CONDITIONS. (Fluor-Wirkungen beim Rind unter experimentellen und praktischen Bedingungen.) Translated from German. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, Contract No. CPA 22-69-30, Project No. C 2439, 31p., 1968. 16 refs.

In the period from 1961 to 1967 fluorosis was experimentally induced in test cattle by feeding them primarily with locally grown, fluorine-containing forage to which sodium fluoride or cryolite had been added. The total fluorine intake by the NaF-fed cows was 1.94 mg F/kg body weight per day, and by cryolite-fed cows 2.48 mg F/kg body weight per day. The fluorine intake thus exceeded the threshold value of about 1.75 mg F/kg body weight per day given in the pertinent literature. Fluorine elimination with the feces was found to be about 0.5 g of F per animal per day with NaF-fed cows and 0.9 g of F per animal per day with cryolite-fed cows. Along with the urine, 0.45 mg of F per animal per day were discharged by NaF-fed cows and 0.3 mg of F per animal per day by cryolite-fed cows. The analysis of tail vertebrae biopsies yielded a fluorine retention of 245 to 890 mg F/100 g ash over the period from 1960 to 1966 for the NaF-fed cows, and of up to 655 mg F/100 g ash for the cryolite-fed cows. The clinical symptoms of fluorosis were slight to moderate yellowish, brownish spots as well as hypoplasia of the incisors, furthermore, weak and temporary functional disturbances of the motility were observed with some cows. The severity of these clinical symptoms were found to be dependent on the degree of fluorine emission. The general physical condition as well as the productivity of the test cows were in most cases satisfactory to excellent. Observations concerning spontaneous fluorosis in the Rheinfelden (Baden) emission area during the past 15 years show that the number and the severity of the disease in six communities had reached a peak in 1958 from whereon a steady decrease of the number of cases is found. This downward trend was parallelled by a decrease of the average fluorine content in the locally grown forage below the tolerance limit.

19124

Compton, O. C., L. F. Remmert, J. A. Rudinsky, L. L. McDowell, F. E. Ellertson, W. M. Mellenthin, and P. O. Ritcher

NEEDLE SCORCH AND CONDITION OF PONDEROSA PINE TREES IN THE DALLES AREA. Preprint, Oregon Agricultural Experiment Station, Corvallis, Miscellaneous Paper 120, 6p., 1961. 8 refs.

A survey was designed to determine the nature of the injury to pine trees growing in and around the Dalles area in Oregon. Considerable injury from 'blight', or needle scorch, was found. Scorched needles contained considerably more fluorine than unscorched needles and were typical of 'ponderosa pine blight.' In the Dalles area, the percentage of scorch in 1960 needles varied from 0.9% at Station 12, which was 4 miles south of an aluminum factory, to 67.7% at Station 4, which was 1.2 miles WNW of the factory. The fluorine contents were 23% and 98%, respectively. The greatest amount of scorch was associated with higher fluorine content. No scorch was found in samples outside the Dalles area, and these samples were low in fluorine content. There was no pathological, entomological, or soil conditions that would account for the needle scorch found in the area. (Author conclusions modified)

19358

Compton, O. C., L. F. Remmert, and W. M. Mellenthin

COMPARISON OF FLUORINE LEVELS IN CROPS BEFORE AND AFTER ALUMINUM FACTORY OPERATIONS IN THE DALLES AREA. Oregon Agricultural Experiment Station, Corvallis, Miscellaneous Paper 95, 27p., 1960. 7 refs.

The fluorine content of seven crops in the Dalles fruit area in Oregon were studied, beginning in August, 1953. Determinations of leaf fluorine were made four times previous to and three times since July 26, 1958, when a local aluminum reduction factory began operations. Leaf samples taken before July 1958 averaged less than 12 ppm fluorine. Similar samples taken after the start of operations at the factory ranged from 16 to 197 ppm, averaging 68 ppm fluorine. The June 1959 samples ranged from 6 to 106 ppm, averaging 26 ppm fluorine; those collected in August ranged from 18 to 207 ppm, averaging 73 ppm fluorine. The fluorine samples taken in October 1958 decreased from an average 140 ppm, 1 mile from the factory to 54 ppm, 4-5 miles away. Fluorine burn on leaves was severe in 1959 on certain apricot and prune trees growing within 2 miles of the factory. Peaches collected in 1959 showed a premature ripening and softening along the suture, the swelling often extending to the apex. This condition has not been observed previously in this area. (Author summary modified)

20872

Rippel, A

LONG TERM EFFECT OF FLUORIDE EMISSIONS UPON VEGETATION. Fluoride Quarterly, J. Intern. Soc. Fluoride Res., 3(1):18-21, Jan. 1970. 7 refs.

The results are presented of an eight-year study of the fluoride content of fruit, vegetables, and grain grown in four communities near a Czechoslovak aluminum factory. In the community nearest the factory, the fluoride levels in fruit and grain were five and six times higher, respectively, than those of controls. However, the fluoride levels in grain were only 2.6 times as high as in the controls. Root vegetables, especially potatoes, exhibited only minor changes in fluoride content, suggesting that fluoride uptake by plants is independent of fluoride levels in soil. In tuberous vegetables, fluoride accumulated in the portions of the plants growing above ground rather than in the tubers. This fact points to fluoride uptake from the air. The fluoride levels observed after the long-term exposure of plants were above normal. Fruit trees deteriorated progressively, particularly the sensitive plum trees and grape vines. The long-term emissions also distinctly decreased the biological and organoleptic values of the agricultural product and the productivity of agricultural plants.

21062

Sobocky, E.

PRELIMINARY RESULTS OF ECONOMIC AND SYLVICULTURAL MEASURES AGAINST THE EFFECTS OF FLUORINE IN THE REGION OF ZIAR N.HRONOM. (Predbez vysledky lesnickohospodarskych opatreni proti pusobeni fluoru v oblasti Ziaru n.Hronom). Scientific and Technical Society, Prague (Czechoslovakia), Agriculture and Forestry Section, Proc. Conf. Effect Ind. Emissions Forestry, Janske Lazne, Czechoslovakia, 1966, 10 refs. (Oct. 11-14.) Translated from Czech. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, p. XIII-1 to XIII-13. April 24, 1969.

Results of research and sylvicultural and economic measures taken to reduce the harmful effects of emissions in the area of Ziar N.Hronom were summarized. The source of the emissions was a metallurgical plant producing aluminum. The sylvicultural measures were first directed toward the most severely attacked zone I of the area, and on non-sylvan areas, which were not used to grow trees, located within the reach of the maximum smoke attack between the forest boundary and the plant. In zone I, practically all degrees of injury were found, starting with depigmentation and necrosis formation in assimilation organs, up to the loss of foliage and decay of conifers. From among four-year plants on unforested land, which were subjected to various cultivation operations including mineral fertilization, best results were obtained for black alder, birch, red oak, pedunculate oak, and Austrian pine. Fertilization with lime and ground Thomas slag proved efficient only in the case of black alder. A much better result was provided by hoeing and mowing. Successful foresting depends not only on exposure to the emitting source, but also on a lower HF concentration. Terrian relief creates a natural barrier to penetrating emissions. The beech stand, situated 2110 m eastward of the emitting source, reduced the detrimental effect of HF in its above surface layer by approximately 30% in comparison to a free area in front of the stand boundary. A ten-year pine culture, 1950 m south-southeast from the source, reduced the harmful effect of HF by approximately 50% by comparison to total clearing, and thus fulfilled the protective function by being in front of the sheltered trees.

22085

Compton, O. C., L. F. Remmert, and W. M. Mellenthin

FLUORINE LEVELS IN CROPS OF THE DALLES AREA IN 1964. Oregon Agricultural Experiment Station, Corvallis, Special Rept. 204, 21p., 1965. 5 refs.

In 1964, the fluorine content of sweet cherry leaf samples collected in July ranged from 4 to 31 ppm, averaging 11 ppm. Samples collected in September contained from 6 to 52 ppm fluorine, averaging 19 ppm. The data for peach trees were similar. Even though these fluorine levels were much lower than in 1960-62, the effect of distance and direction from the aluminum reduction factory is evident. There was no discernible trend in fluorine levels because of location within The Dalles area before the opeation of the factory. Fluorine samples from the air varied from none to 2.5 micrograms/cu m of air. The relationship between the fluorine in the air and in

foliage of Royal Ann cherry trees indicated that the higher the air fluorine, the greater was the leaf fluorine content. (Author summary modified)

22092

Compton, O. C., L. F. Remmert, and W. M. Mellenthin

FLUORINE LEVELS IN 1961 CROPS OF THE DALLES AREA. Oregon Agricultural Experiment Station, Corvallis, Special Rept. 153, 25p., 1963. 6 refs.

The fluorine content of the foliage or forage of alfalfa, apricot, cherry, sour cherry, grape, peach, and prune crops grown in The Dalles area in Oregon during 1961 are reported. These data are compared, in tabular form, to similar data obtained previously. Leaf samples collected from the crops in July 1961 ranged from 12 ppm to 217 ppm fluorine, averaging 65 ppm. Samples taken in September ranged from 16 to 204 ppm, averaging 68 ppm fluorine. Leaf Scorch on apricot trees and soft suture on peaches were observed. These conditions were noted in 1959 and 1960, but not before the operation of an aluminum factory located in this area. The effects of calcium chloride and fluoride spray treatments were also investigated. (Author summary modified)

22496

Kazantseva, E. N.

ASSORTMENTS OF GAS-RESISTANT LAWN GRASSES. In: American Institute of Crop Ecology Survey of USSR Air Pollution Literature. Effects and Symptoms of Air Pollutes on Vegetation; Resistance and Susceptibility of Different Plant Species in Various Habitats, In Relation to Plant Utilization for Shelter Belts and as Biological Indicators. M. Y. Nuttonson (ed.), vol. 2, Silver Spring, Md., American Institute of Crop Ecology, 1969, p. 50-55. (Also: Tr. Inst. Ekologii Rasteniy Zhivotnyhk (Sverdlovsk), vol. 54:91-95, 1967.)

Investigations concerning the gas resistance of lawn grasses were conducted at a Ural aluminum plant where fluorine pollution is present. Photosynthesis and the water regimen were studied in meadow fescue, red fescue, Kentucky bluegrass, red top, and timothy grass. Damage was observed in early spring when the leaves were appearing. There was burn on the tips of the leaves; then spotting and blotching appeared. The damage increased and reached a peak toward the end of the growing season. The smallest percentage of damage was observed on meadow fescue, red fescue, and Kentucky bluegrass, while the greatest damage was found on red top and timothy grass. Fluorine compounds decreased photosynthesis, water-holding capacity, and the quantity of free water. Slightly damaged species have a lower photosynthetic intensity, greater water-holding capacity, and more free water than the severely damaged grasses. Meadow fescue, red fescue, and Kentucky bluegrass are recommended for industrial sectors with severe fluorine pollution. Red top, 'regneria', Awnless bromegrass, and timothy grass are suggested for sectors with little pollution.

23386

Cormis, L. de

ABSORPTION AND ACCUMULATION OF ATMOSPHERIC FLUORINE BY THE LEAVES OF CERTAIN HERBACEOUS PLANTS. (Absorption et accumulation du fluor atmospherique par les feuilles de certains vegetaux herbaces) Ann. Physiol. Veg., 10(4):251-262, 1968. 16 refs. Translated from French. Belov and Associates, Denver, Colo., 24p., June 18, 1970.

The effects of atmospheric fluorine compounds, such as are emitted from aluminum industries, on various leafy plants are investigated. Tomato, bean, and tobacco plants were grown under controlled conditions and subjected to varying hydrogen fluoride concentrations and different atmospheric conditons. The rate of absorption of atmospheric fluorine is clearly proportional to the concentration, time of exposure, and relative humidity. The fluorine is accumulated near the edges of the leaves and results in necroses in that area. The level of toxicity varies from plant to plant. It can be attained from a heavy concentration of short duration, or more probably from a semi-permanent pollution of low concentration. The difference between fluorine and sulfur dioxide absorption is explained.

23579

Hluchan, Eugen, Jan Mayer, and Emil Abel

THE INFLUENCE OF ALUMINUM-WORKS EXHALATIONS ON THE CONTENT OF FLUORIDES IN SOIL AND GRASS. Pol'nohospodarstvo, 10(4):257-262, 1964. Translated from Slovak. Belov and Associates, Denver, Colo. 7p., June 26, 1970.

Between 1958 and 1962, fluoride analyses were carried out on 338 soil samples and 72 grass samples from the vicinity of an aluminum plant. Soil from the south side of the plant showed fluoride values as high as 91.0 mg. Values for the remaining area ranged from 4.8 to 53.1 mg, averaging 20 to 29 mg. In contrast, the average fluoride value for soil from an uncontaminated area was 13.6 mg. Grass samples showed fluorides to a value of 118.7 mg in 100 g of dry substance, while the fluorine content of light dust reached a value of 5.0 mg/100 g of fresh grass. The content of fluorine compounds in soil and grass decreased with increasing distance from the plant. The determined values in the proximity of the plant represent a multiple transgression of the natural content of fluoride in soil and grass.

25195

Lindberg, Gosta

AIR POLLUTION CONTROL IN THE SWEDISH ALUMINUM INDUSTRY. Preprint, International Union of Air Pollution Prevention Associations, 18p., 1970. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper SU-24C.)

Aluminum metal is produced from aluminum oxide through an electrolytic reduction process at an elevated temperature (950-970 C) thereby generating atmospheric impurities containing gaseous and particulate fluorides. The polytoxic effect of even small amounts of fluorides on vegetation is well known and emitted gases from the process have therefore been carefully collected and cleaned in efficient scrubbing equipment. The smelter plant of AB Svenska Aluminiumkompaniet is located close to the town of Sundsval with 65,000 inhabitants. For the latest production stages it has been necessary, not only to clean the primary process gases, but also the huge volumes of ventilation air--at present amounting to 10 million cu ft/hr (6 mill cfm). The collection and cleaning system applied has an overall cleaning efficiency of fluorides exceeding 90%. Damage caused partly by fluoride emission from the older smelter plant on vegetation in adjacent regions has necessitated further dilution of released fluoride impurities. As a result of a combined meteorological and topographical study, 70-m (210 ft) high discharge stacks have been erected. As an instrument for vegetation contrrol in the smelter environment, a botanical study is recommended. Fluorine content determination of pine needles from a number of stations in the surrounding area has proved to be a method of considerable value in this respect. Sampling and analyses are made toward the end of the growing season. Isopleths for fluorides are obtained

by combining testing stations with the same amount of fluoride content. The position of the curves yield information about the actual emission situation an the cleaning system efficiency. The isopleth positions have, however, changed somewhat from year to year-- even without changes being carried out at the plant installations. Meteorological conditions such as amount of rainfall, prevailing wind direction, and rate of inversion appear to be confusing factors when judging the effects of plant extensions or other changes affecting the fluoride emission. Amount of rainfall and wind direction has been measured for years. To study the rate of inversion a mast of 40 m (130 ft) has been erected and equipped with temperature recording instruments at different heights above the ground. Comprehensive meteorological and ecological investigations should be a significant part of the preparatory work when examining the possibilities for further extension of existing plants or the location of new plants. (Author abstract modified)

25661

Rippel, A. and J. Janovicova

THE INFLUENCE OF FLUORINE EXHALATION ON THE FLORA IN THE SURROUNDINGS OF AN ALUMINUM PLANT. (Der Einfluss von Fluorexhalaten auf die Pflanzenwelt in der Umgebung eines Aluminumwerkes. Air Pollution Proc., First European Congr. Influence Air Pollution Plants Animals, Wageningen, 1968, p. 173- 178. Translated from German. Belov and Associates, Denver, Colo., 5p., Nov. 3, 1970.

Examinations of the forest vegetation and agricultural life in the surroundings of an aluminum plant over a period of six years revealed intoxication and injuries to the vegetation by fluorine compounds. The degree of injury differed in correlation with the distance from the plant and the prevailing wind direction. Further studies revealed that plums were a more sensitive indicator to fluorine pollution than apples, pears, cherries, and grapes. Among vegetables the most striking differences were noted with leaf vegetables such as lettuce and cabbage. Wheat showed higher fluorine contents than rye. (Author summary modified)

25665

Balazova, G. and E. Hluchan

THE EFFECT OF FLUORINE EXHALATION ON ANIMALS IN THE SURROUNDINGS OF AN ALUMINUM PLANT. (Der Einfluss von Fluorexhalaten auf die Tiere in der Umgebung einer Aluminiumfabrik). Air Pollution Proc., First European Congr. Influence Air Pollution Plants Animals, Wageningen, 1968, p. 275-279. Translated from German. Belov and Associates, Denver, Colo., 5p., Nov. 3, 1970.

In the vicinity of an aluminum plant, the presence of fluor was examined in the air as well as in the organs of house sparrows and pigeons. The fluor in milk and eggs produced in the immediate vicinity was simultaneously determined. To a various extent and in the majority of samples, a significant increase of fluor contents was observed. The first evidence of damaging results was fluorosis in the cattle. (Author summary modified)

26258

Williams, Charles R.

AIR POLLUTION FROM FLUORIDES. J. Air Pollution Control Assoc., 6(2):100-102, Aug. 1956. (Presented at the Air Pollution Control Association, 49th Annual Meeting, Buffalo, May 20-24, 1956.)

There has been a long history in the country of severe crop and cattle damage in several areas caused by air pollution from fluorides. Rock phosphate and fluorspar and other ores of fluorine compounds are the major sources responsible for this pollution problem. A brief review of production figures for these materials defines the extent of the problem. Phosphate rock is utilized primarily for the production of superphosphates (fertilizers), food and medicinal phosphates, elemental phosphorus, phosphoric acid, ferro-phosphorus, and stock and poultry feed. The important sources are in Florida, Tennessee, Idaho, Montana, Utah, and Wyoming. Utilization of fluorides, particularly in production of aluminum and steel, provides another large-scale source of fluoride pollution. The use of fluorides in the production of aluminum is discussed, as well as the release of fluoride in the production of elemental phosphorus and superphosphates.

26978

Kazantseva, E. N.

RESISTANCE OF SOME GRASSES TO FLUORINE. In: American Institute of Crop Ecology Literature. Effects and Symptoms of Air Pollutes on Vegetation; Resistance and Susceptibility of Different Plant Specie in Various Habitats, in Relation to Plant Utilization for Shelter Belts and as Biological Indicators. M. Y. Nuttonson (ed.), Vol. 2, Silver Spring, Md., American Institute of Crop Ecology, 1969, p. 56-59, 4 refs. (Also: Okhrana Prirody na Urale, 1966:45-47.)

Experiments were set up in an aluminum plant to select some grasses resistant to fluorine. Test pilots were located near the electrolysis shop where the concentration of fluorine was 0.612 mg/cu m, while the control plots were located at a distance some 2000 m from the source of pollution. Additional experiments were conducted in chambers where the plants were fumigated for 8 hours with concentrations of 0.8 and 0.03 mg/cu m. The species planted were as follows: meadow fescue, red fescue, Kentucky bluegrass, perennial ryegrass, meadow foxtail, timothy grass, redtop, awnless bromegrass, meadow brome, and roegneria. Observations were recorde regarding damage to the leaves, and the plant height was noted in relation to the fluorine concentration. The water retention abilit of leaves was studied, and the quantity of oxidizable substances was determined. At the end of the growing period, injury to the meadow foxtail, awnless bromegrass, meadow brome, and roegneria was 50-60%. The least injury (25-35%) was noted with Kentucky bluegras and red fescue. Compared with the control plants, the plants grown at the aluminum mill were smaller. The species having the greater water retention capacity were least injured. Determination of oxidizable substances in the cell content showed that meadow fescue has the least amount of them, whereas redtop the largest. Meadow fescue, red fescue, and Kentucky bluegrass are recommended as suitable for planting in the industrial areas having the highest fluorine concentrations.

32516

Knabe, Wilhelm and Karl-Heinz Guenther

CONTRIBUTIONS OF FORESTRY TO THE ENVIRONMENTAL PROTECTION IN NORTH RHINE WESTPHALIA. (Forstwissenschaftliche Beitraege zum Umweltschutz in Nordrhein-Westfalen). Text in German. Allg. Forstz., 26(24):503-506, 513-514, June 1971. 28 refs.

The contribution of forestry to environmental protection consists primarily of observations of the effects of air pollutants on trees and plants. The results from indoor exposure test (in greenhouses) do not always reflect the true situation. In open air exposure experiments, young spruce trees grown from seeds were less resistant than scions, whose needles had all the characteristics of those of an old tree. In outdoor gasification experiments, spruces, set up at different levels above the

ground, were exposed to the emissions from an aluminum plant. The higher elevated plants were exposed to more fluorine because of greater air ventilation. Tall old trees were injured while young ones growing next to them were seemingly healthy. Although more fluorine was absorbed by the plants, it was eliminated again after some time. In North Rhine Westphalia, forests with an average sulfur dioxide concentration of more than 0.08 mg/cu m during the growing season over three quarters of all measurement years were unsuitable for the growth of any coniferous trees with the exception of Pinus nigra Arn.

32535

Bovay, E. and R. Zuber

NECROSES ON APRICOTS: GASING EXPERIMENTS WITH HYDROFLUORIC ACID. (Necroses sur abricots: essais de gazage au moyen d acide fluorhydrique). Text in French. Revue Suisse de Viticulture et Arboriculture (Lausanne), 3(3):78-81, May-June 1971.

Necroses on apricots were frequently observed in the alpine valleys where certain chemical and metallurgical industries, particularly aluminum factories, were emitting fluorine into the atmosphere. Gasing experiments were conducted with various concentrations of hydrofluoric acid on apricot trees and picked fruit. Meteorological conditions of temperature, humidity, and precipitation were observed. Exposure to hydrofluoric acid caused necroses to appear on the leaves and the apricots similar to the necroses on the fruits affected by industrial fluorine emissions. A dry climate, high temperature, fine precipitation followed by long periods of sunny weather, followed in turn by more dry spells were favorably correlated to the appearance of necroses.

32536

Bolay, A., E. Bovay, G. Neury, J. P. Quinche, and R. Zuber

DAMAGE TO APRICOTS AND OTHER FRUITS CAUSED BY FLUORINE COMPOUNDS. (Degats causes aux abricots et a d autres fruits par les composes fluores). Text in French. Revue Suisse de Viticulture et Arboriculture (Lausanne), 3(3):82-92, May-June 1971. 49 refs.

Stone fruits (apricots, peaches, plums, and cherries), pears, and applies grown in the alpine valley (Valais, South Tirol, and Savoy) were examined for fluorine-induced damages. Climatic conditions, particularly temperature, humidity, and precipitation, were observed and correlated. Symptoms of fluorosis on the stone fruits were characterized by well-delimited brown-black necroses, sometimes surrounded by a reddish aureole. The necroses were deep and reached to the stone on very young fruits and were rather superficial on fruits approaching maturity, which were most sensitive to fluorine. Pears gave similar results. Fluorosis on apples appeared as a reddening of the epidermis and rifts appearing around the apex or on the most exposed side. The apples were deformed. Damage symptoms were identical regardless of the origin of the fluorine: atmospheric pollution, fluorine salts sprayed on the fruit, or absorption by the roots from fertilizers containing fluoborate compounds.

32539

Bolay, A., E. Bovay, J.-P. Quinche, and R. Zuber

AMOUNTS OF FLUORINE AND BORON IN THE LEAVES AND FRUITS OF FRUIT TREES AND VINEYARDS, FERTILIZED BY CERTAIN BORON- AND FLUORINE-CONTAINING FERTILIZERS. (Teneurs en fluor et en bore des feuilles et des fruits d arbres fruitiers et de vignes, fumes avec certains engrais composes, boriques fluores). Text in French. Revue Suisse de Viticulture et Arboriculture (Lausanne), 3(3):54-61, May-June 1971. 14 refs.

Various orchards and vineyards were examined for absorption of fluorine and boron from the atmosphere and certain fertilizers by the fruits and leaves. Apricot trees grown in the orchards of Rechy were affected by fluorine emissions from certain aluminum factories. The amount of fluorine in the leaves was proportional to the age, regardless of the fertilizer. Young leaves, that emerged in the hot summer months, were most damaged by the fluorine emissions but contained the least fluorine. Conversely, the youngest leaves were richest in boron content. Apricot orchards in Bieudron and Fey, areas of minimal air pollution, had very few appearances of necroses. The fluorine content in the leaves remained in the range of 17-28 ppm. A stronger application of fertilizer increased the fluorine content but had no notable effect on the boron content or chemical composition of the apricots. Comparable results were gathered in one of the apricot orchards in Martigny. The other, exposed to fluorine emitted by an aluminum factory, had a higher fluorine content in the leaves. The treatment of apricot trees by a fungicide containing fluorine had no effect on the fluorine content. The boron content was clearly increased upon application of the boron-containing fertilizer, but the fruits did not absorb the fluorine of the fertilizer. Tests on orchards in Marcelin and Changins, areas virtually free of fluorine in the atmosphere, determined an increase in fluorine content in the leaves and of necroses due to the fertilizer. Plum and pear trees examined under similar conditions gave comparable results, with slight variations for different variables of pollution and fertilizer. Vineyards were also tested in Valais. General results indicated that the combined boron-containing fertilizers determined an evident accumulation of fluorine in the leaves of the plants but had no effect on the fluorine content in the fruits, which was proportional to the degree of pollution by industrial fluorine emissions in the atmosphere.

32897

Desbaumes, P. and E. Bovay

DETERMINATION OF FLUORINE-IMMISSIONS BY MEANS OF STATIC ABSORPTION APPARATUS (MODIFIED HARDING METHOD). (Determination des immissio fluorees au moyen d appareils d absorption statique, type Harding modifie). Text in French. Revue Suisse de Viticulture et Arboriculture (Lausanne), 3(3):75-77, May-June 1971.

A modified Harding apparatus was used to determine the correlation between fluorine in the air and in plant leaves. The device consists of a galvanized armature attached to a pole, a group of superimposed discs holding filter paper, and a conical roof protecting the device from rain and bird droppings. The fluorine content was determined by the Belcher and West method modified by Sulzberger after the calcination of a one gram filter paper sample with calcium hydroxide. Measurements were taken near an aluminum factory and near a fertilizer plant. The fluorine content in the filters was directly proportional to the duration of exposure and inversely proportional to the distance from the source of the fluorine. The absorption of fluorine by filter paper is much less than by plant tissues because of respiration and evapotranspiration.

33906

Paluch, Jan and Irina Schalenkowa

AIR POLLUTION BY FLUORINE IN POLAND AND ITS TOXIC EFFECT ON HUMANS, ANIMALS AND PLANTS. (Die Luftverunreinigung durch Fluor in Polen und ihre tox-

ische Wirkung auf Menschen, Tiere und Pflanzen). Text in German. Wiss. Z. Humboldt Univ. Berlin Math. Naturw. Reihe, 19(5):489-492, 1970.

The major sources of the emission of fluorine compounds to the atmosphere are aluminum phosphorus fertilizer manufacturing plants. In Poland, the superphosphate industry alone produces a fluorine emission of some 4000 to 5000 tons annually, the aluminum industry some 2000 tons. Fluorine has a toxic effect on plants and animals, generally in an area within a radius of 1.5 to 3 km. External symptoms on plants are necrosis of leaf borders which can lead to destruction of their metabolic system and eventual plant death. Some plants, like cabbage, are more resistant than others in this respect. Peach leaves, for instance, are extremely sensitive to fluorine concentrations. The plants in general absorb the fluorine through their leaves and store it; such afflicted plants represent a danger to animals and human beings if taken in as food. The biological and clinical symptoms of fluorosis are due to changes in the calcium and iodine balance in the human or animal organism. Typical externally noticeable symptoms in animals are deformations of long bones, ribs, and joints, followed by lameness. Young animals show disturbances in growth and changes on their teeth. In humans, the most well-known effects are those brought about by fluorine in drinking water. Acute fluorine poisoning can be caused by intake of food which has been contaminated by fluorine compounds. These occur in some insecticides and in some plant sprays.

36883

LeBlanc, Fabius, Gilberte Comeau, and D. N. Rao

FLUORIDE INJURY SYMPTOMS IN EPIPHYTIC LICHENS AND MOSSES. Can. J. Botany, 49(9):1691-1698, 1971. 22 refs.

To study in situ the effects of fluorides on lichens and mosses, lichen- and moss-bearing bark discs were cut from trees in an unpolluted area of Arvida, Quebec, and transplanted in groups of six onto trees in an area polluted by an aluminum factory. Fifteen sites, in addition to a control site, were selected in different directions from the factory. At each site, two boards on which the bark discs were fixed were nailed to a tree. One board was removed after four months exposure and the other after 12 months. The lichens and mosses in both control and polluted areas were compared with respect to color, external morphology, plasmolysis in algal cells, loss of green color, nature of reactions toward neutral red and 2,3,5-triphenyl-2H-tetrazolium chloride, absorption spectra of chlorophyll, and fluoride concentrations. Results indicate that fluoride pollution affects moisture balance, causes chlorophyll damage, and produces other symptoms of injury which could lead to the ultimate death of these organisms. At the end of 12 months, lichen fluoride concentrations ranged from 134 ppm at 15 km NE of the factory to 990 ppm at one km E. Moss fluoride concentrations were always lower than lichen concentrations. (Author abstract modified)

36996

Hajduk, Juraj

EXTENSION GROWTH IN SEEDLINGS AS A BIOLOGICAL TEST OF SOILS CONTAMINATED WITH FLUORINE EXHALATES. (Verlaengerungswachstum de Keimlinge als biologischer test von durch Fluorexhalate intoxizierten Boeden). Text in German. Biologia, 24(10):728-737, 1969. 19 refs.

Biological tests based on measurements of pea and barley seedling root extension growth to evaluate the toxicity of fluorine exhalates from an aluminum plant were carried out. The aluminum plant is located in the Hron River Valley and exposed to northwest and north winds with a hilly background on its southern side; the location is characterized by 30% still days/year. Soil located varying distances from the emission source and control soil treated with known amounts of dust from the fusion electrolysis shop of the factory were used for the seedling growth experiments. Lowest growth rates of pea seedling roots appeared on the soil exposed to the highest amounts of fluorine contamination as affected by meteorological and topographic interactions. Inhibition of pea seedling root growth was well correlated with the amounts of fluorine-contaminated dusts added to the control soils. Pea seedlings can be utilized as a biological testing species for the evaluation of fluorine contamination of soils exposed to this pollutant. Barley seedlings elicited irregular reactions and, thus, were rejected as unsuitable for similar tests.

37480

Rippel, A.

EFFECT OF FLUORIDE EMISSION ON ANIMAL PRODUCTS. Fluoride, 4(2):89-92, April 1971. 8 refs. (Presented at the International Society of Fluoride Research Conference, Annual, 3rd, Vienna Austria, March 22-25, 1970.)

Fluoride assays were made over a 3-year period of milk and eggs produced by animals raised within 100 m of an aluminum smelter. Milk from eight cows, 4 to 9 yrs old, averaged 0.6 mg fluoride/l. Milk produced in the morning contained an average of 0.5 mg F, while evening milk contained 0.7 mg F/l. The highest fluoride, content, an average of 0.94 mg/l for 18 months, was noted in the milk of a young heifer. The F(-) in th yoke of chicken eggs averaged 1.2 ppm. This value was only slightly higher than that of the controls (1.1 ppm). However, the fluoride content of egg shells in the exposed area was nine times higher than in the control eggs. The differences in thr fluoride content of milk and eggs confirms the fact that poultry are relatively more resistant to fluoride emissions than cattle. (Author abstract modified)

38017

Guderian, R., H. van Haut, and H. Stratmann

PLANT-DAMAGING HYDROGEN FLUORIDE CONCENTRATIONS. (Pflanzenschaedigende Fluorwasserstoff-Konzentrationen). Text in German. Umschau (Berlin), 71(21):777, 1971. 2 refs.

Because of increased emissions of fluorine-containing gases from plants manufacturing aluminum, copper, superphosphate, glass, or cement, tests were conducted to determine the effect of various concentrations of atmospheric hydrogen fluoride on a variety of plants. Varying harmful effects were noted with concentrations of 0.85-4.2 micrograms/cu m in air, but no definite conclusions regarding allowable concentration limits were reached.

38404

MacIntire, Walter H.

AIR VERSUS SOIL AS CHANNELS FOR FLUORIC CONTAMINATION OF VEGETATION IN TWO TENNESSEE LOCALES. Interdepartmental Committee on Air Pollution, Washington, D. C., Air Pollut., Proc. U. S. Tech. Conf., Washington, D. C., 1950, p. 53 - 58. 2 refs. (May 3-5, Louis C. McCabe, ed.)

Long-term (20-year) field and experimental studies are reported of the processes through which forage vegetation may acquire an abnormal fluorine content; the work was initiated in

response to complaints that fluorine emissions from nearby industry were causing damage to plants and livestock. Results indicate that soils possess distinctive capacities to fix additive fluorides against rain-water leaching and against migration of the fluorine ion into above-ground forage crops, and that such migration is repressed in soil systems that contain adequate supplies of calcium. Abnormal fluorine content in the vegetation of certain locales in Blount County (eastern Tenn.) is attributed to direct contamination from the hydrofluoric acid that is emitted to the atmosphere through the manufacture of aluminum. In the absence of fluoric dusts and without mechanical pollution from phosphatic soils, fluoric contamination of forage vegetation in Maury County (middle Tenn.) apparently comes directly from the fluoric effluents present in that atmosphere, rather than through uptake of florides from the soil. (Author summary modified)

38417

Largent, Edward J.

THE EFFECTS OF AIR-BORNE FLUORIDES ON LIVESTOCK. Interdepartmental Committee on Air Pollution, Washington, D. C., Air Pollut., Proc. U. S. Tech. Conf., Washington, D. C., 1950, p. 64 - 72. 12 refs. (May 3-5, Louis C. McCabe, ed.)

Fluorides carried through the air and deposited on pastures and fields of forage pose a hazard of chronic fluorosis to livestock fed on these plants. Previous reports on the mechanism and symptoms of fluorosis occurring in livestock near factories are reviewed. An investigation is described in which cattle kept on a farm in the vicinity of a rock phosphate plant developed clinical fluorosis. The results of measurements of fluoride concentrations in the atmosphere over the farm, in samples of vegetation grown on the farm, and in the tissues of the exposed cattle are given. Fluoride levels in both air and vegetation decreased as the distance from the factory increased. Concentrations of fluoride in the bones of affected animals were abnormally high.

38568

Treshow, Michael

FLUORIDES AS AIR POLLUTANTS AFFECTING PLANTS. Ann. Rev. Phytopathol., vol. 9:21-44, 1971. 91 refs.

The pathological effects of fluorides on plants are reviewed with respect to fluoride sources, symptomatology, environmental influences, host-parasite relations, injury control, and air quality standards. The major sources of flouride emissions are producers of aluminum, ceramics, phosphate, and occasionally steel. Toxic concentrations of fluoride are largely airborne and absorbed by the leaves. Fluorides occur naturally in soils, but soil contamination may occasionally also provide an index of corresponding air contamination. Toxicity is influenced primarily by fluoride concentration, duration of exposure, and sequence and frequency of exposure, but may be modified by climate, e.g., temperature and humidity, soil factors, synergistic effects of other pollutants, and biological factors. Visible symptoms of fluoride damage, e.g., chlorosis, necrosis, and tip burn, metabolic and cytogenetic effects, and effects on growth and production are considered. The effects of fluorides on host-parasite interaction are also discussed. Fluoride injury controls include the application of protective chemicals, the development of resistant species, and basic elimination of the pollutant. For the highest degree of control, air quality standards are best based on the atmospheric fluoride concentrations capable of injuring the most sensitive plant species.

39159

Rippel, A.

FLUORIDE INTAKE FROM FOOD. Fluoride, 5(2):89-91, April 28, 1972. 3 refs. (Presented at the International Society for Fluoride Research, Annual Conference, 4th, the Hague, Netherlands, Oct. 24-27, 1971.)

In order to evaluate the safety of food grown near a Czechoslovakian aluminum smelter, grain and vegetables were assayed for their fluoride content at varying distances from the smelter during a 10 year period. The fluoride content of green parsley leaves was 11.57 ppm (control 0.66); the roots contained 0.08 ppm (control 0.03) and the outer surface of root contained 0.12 ppm (control 0.03). Relatively little fluoride was found in potatoes. At a distance of 80-130 m in the area of the prevailing winds, the fluoride content of the grain varied within 6.34-19.64 mg/kg. At a distance of 500 m, the fluoride levels of grain were reduced to about 35% and at 1 km to about 15% of these values. Grain cultivated in a circular area with a diameter of 2 kilometers from the source of emission should not be consumed locally but can be exported for use in uncontaminated areas, and fluoride should not be added to drinking water in the vicinity of a fluoride-emitting factory. (Author summary modified)

39684

Plagnat, Francois

MISTLETOE, INDUSTRIAL FUMES AND THE MAURIENNE FORESTS (SAVOIE). (Gui, fumees industrielles et forets de Maurienne (Savoie)). Text in French. Rev. Geog. Alp., no. 59:326-342, 1971. 23 refs.

Attention is drawn to the dramatic situation of the fluorine-damaged Maurienne forests. The first damage of these mistletoe forests, consisting of 90% coniferous trees, were observed in 1910 when nearby aluminum production started. The upper limit of the fluorine damage rose successively to altitudes of 1600 and 2200 m, while the attack of mistletoe was unimporant above 1000- 1400 m. Now, a forest area of nearly 10,000 ha is affected. The damage caused to mistletoe aggravated by the severe damage due to hydrofluoric acid. The losses due to smoke damage show an increase of 58% in the period 1956-1968, compared to the period 1950-1955. At the same time, production by the nearby aluminum plants increased from 43,000 t/yr in 1954 to 92,000 t/yr. The total fluorine emission is 1820 t/yr. Gas cleaning should be introduced. Irrespective of such steps, however, experiments are being carried out with American smoke-resistant Thuya plicata in a 75 ha-area. Measures by the newly-established Department of Environmental Protection are anticipated.

40201

Huffman, W. T.

EFFECTS ON LIVESTOCK OF AIR CONTAMINATION CAUSED BY FLUORIDE FUMES. Interdepartmental Committee on Air Pollution, Washington, D. C., Air Pollut., Proc. U. S. Tech. Conf., Washington, D. C., 1950, p. 59-63. 16 refs. (May 3-5, Louis C. McCabe, ed.)

Chronic fluorine toxicosis in livestock can be caused by aerial contamination of forage with fluorine effluents from nearby industry, principally phosphate and aluminum processing plants, although cement plants and enameling works may also be involved. The extent of the area involved is governed by the volume of fluoride effluents, the form in which they occur, and meteorologic factors. Effects on livestock depend on the level of intake, duration of the feeding period, the class of animals involved, and feeding and management practices. The symptomatology is described; dental fluorosis and bone lesions

are prominent. Normal and threshold levels of fluorine in bone tissue and normal and excess urinary levels are noted. Dairy cattle appear more susceptible to fluorosis than beef breeds, but neither meat nor milk from affected animals is likely to be injurious. Complicating factors unrelated to fluorosis should be considered, since most of the symptoms may be present in a variety of diseases. Disease control requires reduction of emissions to the point where nearby forage contains a safe level of fluoride.

40472

Neustein, S. A., and N. P. Danby

POTENTIAL ATMOSPHERIC POLLUTION FROM THE INVERGORDON INDUSTRIAL COMPLEX. Scot. Forest., vol. 24:270-273, Nov. 1971. 5 refs.

The main atmospheric pollutants from the Invergordon complex will be fluorine and hydrogen fluoride from the aluminum smelter and sulfur dioxide and hydrocarbons from the oil refinery. Both acute and chronic tree damage is expected. The effects of F and SO2 on the trees via the soil is expected to be insignificant. Acute tree damage results from high concentrations of pollutants as a result of meteorological conditions or industrial cleansing failure. Chronic tree damage results from long term low level pollution. Broad leaved trees are not regarded as susceptible to chronic pollution. All the conifers are susceptible. Clean air sampling has begun in order to provide before and after comparison. Foliage samples will be taken for a radius of 16,000 M. A survey of lichens has been completed. Lichenology may assist in discrimination between F and SO2 injuries.

45604

Carlson, Clinton E. and Jerald E. Dewey

ENVIRONMENTAL POLUTION BY FLUORIDES IN FLATHEAD NATIONAL FOREST AND GLACIER NATIONAL PARK. Forest Service, Missoula, Mont., Forest Insect and Disease Branch, 62p., Oct. 1971. 27 refs.

The major cause of vegetation injury and damage on forested lands near the Anaconda Aluminum Company was studied. Research took the form of studies of visual burn, chemical analysis, histological analyses, aerial photography of area, and entomological (insect) sampling. Fluorides generated by the Anaconda Aluminum Company were determined to be the primary cause of the injury and damage to vegetation in the surrounding area. Highest fluoride concentrations, up to 1000 ppm, in foliar tissue were found near the Anaconda aluminum plant. Data indicated the fluorides were carried by air movement from the aluminum plant through a saddle in Teakettle Mountain to Glacier National Park, following the pattern of the prevailing winds in the area. Elevated fluorides (greater than 10 ppm) were found in vegetation on Columbia Mountain and Teakettle Mountain, in vegetation near the towns of Columbia Falls, Hungry Horse, and Coram, Montana, and in the southwest portion of Glacier National Park. Varying degrees of visible fluoride injury were found on vegetation over more than 69,120 acres. Although fluoride emissions were reduced during the summer of 1970, fir and spruce trees continued to accumulate fluorides at the same rate as in 1969. Definite histological reactions to elevated fluorides occur in conifer needle tissue, including hypertrophy of parenchymatous cells. Fluorides also accumulated in insect tissue. All groups of insects studied contained high fluoride levels. Pollinators possessed the highest, up to 406 ppm. Cambium feeders contained in excess of 52 ppm, indicating that fluoride must be translocated in the cambium of trees. Predatory insects had fluoride counts over 53 ppm, showing fluoride is passed along the food chain. Insect population samples indicated that elevated fluoride levels in pine needles lead to a buildup of the pine needle scale. During the summer of 1971, evaluations of possible timber growth losses and pasture grazing lands the should not be utilized due to fluoride were evaluated. Environmental damage can be stopped only by installation of pollution abatement equipment to limit fluoride emission to 0 lb/day, which is impossible, or by closing the plant, which is also impossible. The only possibility left is installing a permanent system to monitor fluoride pollution. (Author conclusions modified)

45663

Compton, O. C., F. W. Adams, Stanley Elliott, Jack H. Wood, D. W. Claypool, and R. K. Marsh

FLUORINE LEVELS IN PLANTS OF THE WARRENTON AREA, 1968-1970: CULTIVATED AND NATIVE WOODY AND HERBACEOUS PLANTS PRIOR TO ALUMINUM FACTORY OPERATIONS. Oregon Agricultural Experiment Station, Corvallis, Rept. 335, 30p., July 1971. 32 refs.

The flourine level of plants in an area intended for construction of an aluminum plant was studied to supply reference data in anticipation of pollution after start of plant operation. Cultivated and native plants within 6 mi of the factory site were sampled. Pasture herbages contained an average of 0.8-3.2 ppm fluorine, with only 11% of the samples exceeding 3.4 ppm. The fluorine content of each of the other six species averaged 2.9 ppm, with the exception of spruce needles containing 4.2 ppm. Five improved strains of pasture grasses maintained in pure strands were consistently and uniformly low in fluorine content. Within the area, differences in terrain, river valley, or distance from projected factory site produced no trends in fluorine concentrations. (Author summary modified)

46217

Swieboda, Maria

CERTAIN ASPECTS OF THE EFFECT OF AIR POLLUTION BY INDUSTRIAL FLUORINE COMPOUNDS UPON FORESTS. (Niektore zagadnienia wplywu na lasy prezemyslowych zanieczyszczen powietrza zwiazkami fluoru). Text in Polish. Sylwan, 108(6):45-54, 1964. 27 refs.

A brief review is given which emphasizes that the content of fluorine compounds in air, soil, and plants differs in different areas depending on the distance from industry (especially metallurgical aluminum, and fertilizers industries). The signs of the adverse effects of fluorine pollution are described in detail. Resistance of plants differs in different species. Of the evergreens, the most sensitive are the pine (75-85%), spruce (26-75%), and fir (3-12%), and least sensitive is the larch (less than 1%). Of deciduous trees, the most sensitive is the beech tree, while maple, oak, and plane trees are much more resistant. Different methods for determining the cause of damage (chemical, botanical, biometric, and histochemical) and methods of plant protection (spraying with lime or special oil emulsions) are briefly described. The need for better control of sources of fluorine pollution is stressed.

46721

Schoenbech, H. and W. Hoelte

DETECTION OF AIR POLLUTION BY THE TRANSPLANTED FOLIOSE LICHEN, PARMELIA PHYSODES. (Zum Nachweis von Luftverunreinigungen durch die transplantierte Blattflechte Parmelia physodes). Zentralbl. Bakteriol., Parasitenk. Infektionskr. Hyg.:Abt. 1:Orig., Reihe B,

212(2/4):356-357, Feb. 1970. 1 ref. Translated from German. 2p.

Open air and fumigation studies indicate that the foliose lichen Parmelia physodes reacts to ground level concentrations of sulfur dioxide and hydrogen fluoride, and that it can be measured by the withering of individual thallus parts. Reactions were photographically recorded at predetermined time intervals. An investigation conducted in the vicinity of an aluminum plant ascertained that Parmelia physodes is a quantitatively reacting biological indicator.

J. EFFECTS-ECONOMIC

29923

Schreiber, Michael

THE COSTS FOR MAINTENANCE OF CLEAN AIR. THE INFLUENCE OF SOCIAL COSTS ON THE SELECTION OF AN INDUSTRIAL SITE. (Kosten der Luftreinhaltung. Der Einfluss der social costs auf die industrielle Standortwahl). Text in German. Wasser Luft Betrieb, 15(4):145-148, 1971. 27 refs.

Because of the cost of eliminating brown smoke emissions, Thomas converters were replaced by oxygen lancing converters. An 80-ton Thomas converter emits about twice as much waste gas as an oxygen lancing converter of the same capacity. Similar changeovers to processes with less waste gas production were made i the chemical industry to save waste gas cleaning costs. Sulfur emissions are reduced mainly by switching to low-sulfur fuels, a much less expensive means than desulfurization of the fuel or the flue gases. Such steps are not always possible. In many cases investment in dust collectors, electrostatic precipitators, and scrubbers are unavoidable. The economy of such units depends on the ratio between collection efficiency and maintenance costs. For electrostatic precipitators investment costs rise proportionally to the degree of collection in the efficiency range between 80 and 95%. A collection efficiency of 95 to 98% requires facilities which are 50% larger, increasing costs by 35% and more. The aluminum industry spends an estimated $50/ton of aluminum of its annual production for facilities to eliminate fluorine emission. The annual operating costs per ton of aluminum are estimated at $8.40. Metallurgical plants spent similar amounts for reduction of their emissions.

30696

LeSourd, D. A., M. E. Fogel, A. R. Schleicher, T. E. Bingham, R. W. Gerstle, E. L. Hill, and F. A. Ayer

COMPREHENSIVE STUDY OF SPECIFIED AIR POLLUTION SOURCES TO ASSESS THE ECONOMIC EFFECTS OF AIR QUALITY STANDARDS. VOL. I. (FINAL REPORT). Research Triangle Inst., Durham, N. C., Operations Research and Economics Div., APCO Contract CPA 70-60, RTI Proj. OU-534, Rept. FR-OU-534, 395p., Dec. 1970. 328 refs. NTIS: PB 197647

Air pollution control costs for mobile sources are presented on a national basis and in terms of unit investment and annual operating and maintenance costs as well as total annual operating and maintenance costs. The analyses cover the estimated emissions and control costs for new cars for Fiscal Year 1967 through Fiscal Year 1976. Control costs for each stationary source, except for residential heating, are shown for 298 metropolitan areas by investment and annual expenditures by Fiscal Year 1976. The impact of control on selected industries and the Nation are also determined. Finally, an extensive bibliography is included. The pollutants from mobile sources selected for analysis are hydrocarbons, carbon monoxide, nitrogen oxides and particulates. The six pollutants for which control cost estimates are made for stationary sources are particulates, sulfur oxides, carbon monoxide, hydrocarbons, fluorides, and lead. Emission standards applied are considered stringent in comparison with many currently in use throughout the Nation. Mobile sources include automobiles and light and heavy-duty trucks. Stationary sources studied include solid waste disposal, commercial and institutional heating plants, industrial boilers, residential heating plants, steam- electric power plants, asphalt batching, brick and tile, coal cleaning, cement, elemental phosphorus, grain handling and milling (animal feed), gray iron, iron and steel, kraft (sulfate) pulp, lime, petroleum products and storage, petroleum refineries, phosphate fertilizer, primary non-ferrous metallurgy (aluminum, copper, lead and zinc), rubber (tires), secondary nonferrous metallurgy, sulfuric acid, and varnish. Data essential for defining metropolitan areas, emission control standards, and relevant process and air pollution control engineering characteristics required to support the cost analyses for each source and the cost impact on each industrial process are presented and analyzed in separate appendixes to this report. (Author abstract modified)

39910

Robinson, J. M., G. I. Gruber, W. D. Lusk, and M. J. Santy

ENGINEERING AND COST EFFECTIVENESS STUDY OF FLUORINE EMISSIONS CONTROL. (FINAL REPORT). (VOLUME I). TRW Systems Group, McLean, Va. and Resources Research Inc., McLean, Va., Office of Air Programs Contract EHSD 71-14, Rept. APTD-0945, SN 16893.000, 411p., Jan 1972. NTIS: PB 207506

Industrial emission sources were inventoried and a study was made of the technical and economic aspects of implementing soluble fluoride emission controls for major industrial sources. Industries included in the study were primary aluminum smelting, iron and steel, electrical power generation, phosphate rock processing, glass manufacture, frit smelting, heavy clay products, expanded clay aggregate, cement manufacture, hydrofluoric acid alkylation processes, HF production, and nonferrous metals smelting and refining. It is technically possible, though not economically profitable, to control soluble fluorides with available devices such as wet scrubbers; the immediate problem lies in implementation of that control, including collection of the evolved fluorides by hoods and similar effluent capture systems for treatment in the abatement devices. Included in the study are discussions of production trends extrapolated to the year 2000, process flow diagrams, estimates of current and projected fluoride emissions analyses of production and control process economics, recommendations for additional research and development programs, environmental and ecological effects of the emitted fluorides on animals, plants, man, glass, and materials, and techniques for sampling and measurement of fluoride pollutants in the various effluent streams.

46362

INCREASING CONSUMPTION STABILIZES SITUATION IN ALUMINUM MELTING PLANTS. (Steigender Verbrauch festigt die Lage der Aluminiumschmelzhuetten). Text in German. Metall (Berlin), 26(9):969-971, 1972.

The Organization of European Aluminum Melting Plants (OEA) forecast an increase of aluminum consumption of more than 9% for 1972. Manufacturing costs also will rise by 10%. This cost rise is mainly due to measures for the protection of the environment. Dust, chlorine, and salt emissions must be limited. Many aluminum melting plants which have not yet been forced to control air pollution still hold illusionary ideas concerning the costs of such measures. The costs comprise costs for filters and buildings, low maintenance and power costs, secondary costs such as filter repairs, during which the furnace operation is halted. Primary and secondary costs amount to about 0.55 to 0.70 cents/lb.

48171

Fredriksen, Heige

POLLUTION PROBLEMS IN THE NORWEGIAN INDUSTRY. (Forurensningsproblemer in norsk industri). Text in Norwegian. Tidsskr. Kjemi, Bergvesen, Met., 32(2):9-14, Feb. 1972.

The state of pollution control and planned investments in various branches of industry in Norway are reviewed. In addition to $70,000,000 already invested in industrial emission control, about $14,000,000 more will be necessary over the next few years. The aluminum industry, with a yearly output of 500,000 tons, has completed a comprehensive emission control program. Some 8000 tons of fluorides, out of a total of 10,000 tons, are collected. The operating cost of cleaning equipment adds $5.60 to the cost of 1 ton of aluminum. Red smoke emissions from iron and steel plants have been considerably abated, from 1000 to 20 kg/hr in one case. The additional costs are 70-118 cents. The chemical industry has invested $9.52 million for emission control equipment, whose operating costs are $9.3 million/yr. Oil refineries, emitting considerable amounts of sulfur dioxide, soot, and hydrocarbons, will invest $1.4 million over the next 2 years in addition to a $2.1 million investment already realized. One refinery recovers 6000 tons of sulfur from high-sulfur raw products yearly. Cement works have invested $5.60 million for electrostatic dust precipitators. Some 70-90% of the total SO2 emission is bound to the clinker. The fish processing industry has invested $.84 million for odor control; while combined scrubbing and incineration would require another $11.9 million. The melting industry has invested $7.28 million for the control of dust emissions. The investments by the wood processing and pulp and paper industries run to $14 million.

K. STANDARDS AND CRITERIA

14443

Knop, W.

AIR POLLUTION CONTROL IN NON-FERROUS METAL INDUSTRIES. II. PARTICULATE AND GASEOUS EMISSIONS OF THE NON-FERROUS METAL INDUSTRY AND EMISSION STANDARDS. (Luftreinhaltung im NE-Metall-Betrieb. II. Staub-und gasfoermige Emissionen der NE-Metallindustrie und die Emissionsbegrenzung.) Text in German. Metall., 22(12):1266-1271, Dec. 1968. 21 refs.

In this review article, the West German air pollution laws and regulations as applied to metallurgical plants are compiled and discussed. In the aluminum industry, dust arises both in the production of aluminum oxide from bauxite and in the electrolytic furnaces. The most dangerous component of the waste gas is fluoride of which the maximum allowable concentration is 2.5 mg/cu m. Lead refineries emit considerable amounts of dust, up to 15 g/cu m waste gas, which contains metal compounds in the form of sulfates, oxides, sulfides, and coke dust. The pollutants originating in the various steps of lead production are discussed in detail. The threshold limit value (TLV) of lead is 0.2 mg/cu m. Electrometallurgical furnaces for iron and steel alloys emit very fine dusts (less than 0.4 micrometer), typically up to 250 kg/hr at 10,000 kva capacity. Metal oxides predominate, especially iron and silicon oxides. The waste gases of copper ore refineries contain mostly fly dust and sulfur compounds. The dust contains copper, zinc, and sulfur. Typical concentrations at various stages are listed. The TLV of copper is 1 mg/cu m. Emissions of zinc plants are listed, and waste gas and soot emissions of oil, coke, and coal furnaces are discussed in detail. Special problems are posed by scrap metal refineries, where plastics and varnishes cause air pollution. Typical examples are cited.

48204

Jenkins, Richard E. and Gary D. McCutchen

NEW SOURCE PERFORMANCE STANDARDS. Environ. Sci. Technol., 6(10):884-888, Oct. 1972.

The concept and procedure followed in establishing Federal performance standards for new sources and the standards that have been established to date are summarized. Air emission limitations were considered for nine source categories: primary nonferrous smelters, aluminum reduction plants, kraft paper mills, gas turbines, coal cleaning plants, phosphate fertilizer plants, ferroalloy plants, secondary aluminum smelters, and electric arc steel furnaces. Emission tests were conducted and standards were set for sulfur dioxide, nitrogen oxides, particulates, visible emissions, and acid mists from fossil fuel-fired steam generators, municipal incinerators, Portland cement plants, nitric acid plants, and sulfuric acid plants. Testing procedure and data acquisition are described and the emission test results are listed. Emission improvement required and costs resulting from the performance standards are presented. Control equipment is also mentioned.

L. LEGAL AND ADMINISTRATIVE

20273

Fletcher, R. H.

KITIMAT POLLUTION CONTROL BY-LAW. Pulp Paper Mag. Can. (Quebec), 71(7):78-90, April 3, 1970. (Presented at the 5th Paper Industry Air and Stream Improvement Conference, Toronto, Ontario, Oct. 21-23, 1969.)

Land use in the 16-yr-old town of Kitimat, B. C., was planned to minimize the conflicts that can exist between residential areas and industry. Prior to the advent of a pulp and paper complex with a 930 tpd Kraft mill and a 150 million fbm per year saw mill, the town's principle industry was an aluminum smelter. To preserve the quality of its environment, the town passed a waste emission by-law that requires the monitoring of selected emissions from the pulp mill and smelter. The law, to become effective in December 1970, identifies a tolerable level of pollution which is expected to be met, but no exceeded, by the two industries. The level of emission from an industry is related both to the type of equipment used and to the way in which it is operated. The levels, determined from experience recorded elsewhere and those found tolerable by local authorities in an assimilation study, are as follows: cinders from power boilers, 150 gr per 1000 cu ft; sodium compounds, 200 gr per 1000 cu ft. all particulate matter; volatile organic sulfur compounds, 0.2 lbs/ton; calcium compounds, 250 gr per 1000 cu ft all particulate matter; and volatile fluorine compounds, 2.5 lbs/ton.

24949

Behle, Calvin A.

INDUSTRY-THE VIEWS OF THE REGULATED. Arizona Law Rev., 10(1): 74-80, Summer 1968. 19 refs.

Scientific evidence is brining home the fact that perhaps one-fifth or less of the principal atmospheric pollutants in the United State is released from manufacturing plants, including electric power generating complexes. However, industry has shared the irresponsibility of the rest over the decades, and the law books contain many interesting reports of the litigation which hammered out the available legal remedies. In addition to invocation of the law of nuisance, other remedies available and effectively employed were actions sounding in trespass for damage to real property, trespass on the case, and the newer and somewhat more difficult but flexible action of negligence. Among the principal considerations involved in the choice of remedies would be the applicable statute of limitations in the particular forum. Cases are cited which pertain to smelters, oil refineries, aluminum interest, and many other lawsuits arising out of mining and earth processing operations. The National Association of Manufacturers feels that the federal role should emphasize the necessary research and development to prevent and control air pollution, making possible the establishment, scientifically, of criteria to define which levels of pollutants are harmful. Then, the executive branch of the government should have the responsibility of 'leading' rathe than 'driving' the states and communities to abate and control air pollution.

28014

LEGAL NOTE ... LIABILITY FOR AIR POLLUTION. Public Health Rept. (U. S.), 74(2):104, Feb. 1959. 1 ref.

In a suit for damages resulting from fluoride poisoning allegedly caused by the defendant's aluminum reduction plant, the plaintiff was unable to specify any particular acts of negligence by the defendant and was compelled to rely on the legal doctrine of 'res ipsa loquitur' (the thing speaks for itself). This doctrine, according to which the facts of the occurrence warrant the inference of negligence, was held applicable by a court of appeals. The defendant's evidence of reasonable care was considered insufficient to require finding as a matter of law that inference of negligence had been overcome.

29598

Toyama Prefecture (Japan), Dept. of Environmental Pollution

PRESENT SITUATION OF ADMINISTRATION CONCERNING POLLUTIONS. (Kogai gyosei no genkyo). Text in Japanese. 74p., Oct. 1970.

Aluminum smelters and thermal generation stations in the hinterland of Toyama prefecture, have signed an agreement with Toyama Prefecture concerning the prevention of air pollution, but the problem of air pollution is becoming complicated and diversified. Although no concentration is as high as the environmental standard, control was strengthened by amending K 29.2 to 20.4 and adding five observation stations, and a central telemeter monitoring system. Dust collector facilities for electric furnaces lowered the concentration of exhaust smoke from electric furnaces to within the range of standard. With the increase of ferro-alloy, iron, and steel production, on-site checks will be made and guidance will be given on high efficiency dust collecting equipment. With the revision in the sulfur dioxide standard, 56 production facilities, 17% of the factories under control, no longer qualified. At the moment, the chimney height is being raised, a switch to LS heavy oi is being made, and as of the end of March, 1970, about 40% had completed the improvement. Carbon monoxide checks were made in 196 at major locations on traffic congestion in two cities, and they will be continued this year. Since the start of aluminum productio by Sumitomo Chemical Industry, an agreement was signed with the company concerning fluorine. Indicator plants were placed, and on-site checks have been made. Of the 13 staffs on environmental pollution at the prefectural government, four are in charge of air pollution. Of 192 complaints concerning pollution received in 1969 42 were on air pollution. Between September 19, 1969 and October 30, 1969, $583.60 was spent on a survey of air pollution by the prefectural government. As of end of March, 1970, 430 facilities which emit smoke reported in accordance with Air Pollution Prevention Law. Between 1967 and 1969, nine smaller enterprises were given financial aid to improve facilities to prevent air pollution.

36879

Ministry of International Trade and Industry (Japan) and Okayama Prefecture (Japan)

REPORT ON THE SECOND CONFERENCE ON THE MIZUSHIMA AREA AIR POLLUTION CONTROL. (Dainiji Mizushima chiku taiki osen boshi taisaku kyogikai chosa hokokusho). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 7(12):709-723, Dec. 1971.

Okayama prefecture and Kurashiki city formed the Mizushima Area Air Pollution Control Council in Sept. 1967 and began a comprehensive study of the area s air pollution conditions with the general development plan of the coastal industrial complex in the Kurashiki-Mizushima area. A pollution monitoring center was constructed at a central location and the pattern of pollution and transition were studied since then. In spite of the fact that the total emission of sulfur dioxide increased between 1967 and 1971 from 2,751.84 N cu m/hr to 7,981.75 N cu m/hr, the total pollution index has not increased in the area. Up to 1969, high stack emission sources were increased without decreasing the emission amount from low sources, and no improvements had been made on systems at sources. After 1970, collectivization of low emission sources and the use of low-sulfur oil progressed and some measure of pollution control was achieved. As part of the planning for the future development, an air pollution prediction was made upon the projected plan for an area to be newly developed by landfill. Factory layout, possible industrial classifications, production scales, and locations were designed; projected classifications were oil refining, petroleum chemicals, copper refining, aluminum manufacturing, copper wire stretch formation, special steel, glass manufacturing, and shipbuilding. Of these eight industries, three to six were combined, forming four different combinations for simulation tests. Wind tunnel tests were conducted with considerations for seasonal, climatic, fuel, emission gases. If the average sulfur content in fuels is kept under 0.8%, even with the combinations of multi-industries and with the conditions of already functioning industries in the surrounding area, the environmental standard could be maintained.

46561

Loewa, Ortwin

MOSTLY PROTEST AGAINST CITY PLANNING. (Meist Proteste gegen die Stadtplanung). Text in German. Umwelt (Duesseldorf), 2(5):38-42, 1972.

Hamburg is trying to get the help of each resident to combat environmental pollution. In order to create a green belt in the city, newlyweds were asked to plant a tree at a point of their own choice. Unfortunately the trees are threatened by automobile exhaust gases. The erection of an automatic air monitoring station at a cost of 1 million dollars is planned, as is the use of electrically driven garbage collection trucks. The planned erection of an aluminum plant in Stade met heavy opposition from public authorities. The emitted gases from such a plant which contain fluorine compounds which would be carried with the main wind direction East to Pinneberg, which has the largest tree nursery of the world. Another aluminum plant in Hamburg itself is scheduled to begin operation in 1973. Because of the regulations concerning fluorine emissions and red sludge, this plant will begin operation at a later date. Eight agencies deal with the protection of the environment. One environmental protection center coordinates information between the agencies. Since Mid-May of this year, an advisory panel of seven representatives of industry, research, and the public has been created, headed by the mayor of Hamburg. A first report by this panel concerning environmental protection will come out in November.

46586

Frankenfeldt, R. E.

COMPARATIVE CONSIDERATION OF THE ENVIRONMENTAL PROTECTION REGULATIONS CONCERNING THE ALUMINUM INDUSTRY IN VARIOUS COUNTRIES.

(Vergleichende Betrachtungender Vorschriften zum Umweltschutz fuer die Aluminiumindustrie in verschiedenen Laendern). Text in German. Preprint, Gesellschaft Deutscher Metallhuetten und Bergleute, Clausthal-Zellerfeld (West Germany), 13p., 1972. (Presented at the Gesselschaft Deutscher Metallhuetten Bergleute-, Hauptversammlung, Stuttgart, West Germany, April 26-30, 1972.)

The countries of West Germany, France, Great Britain, Italy, the Netherlands, Norway, Austria, Sweden, Switzerland, and Spain have laws concerning environmental protection which are of special interest to the aluminum industry. The laws in West Germany are listed as example. West Germany, Italy, Norway, Sweden, and Spain have laws specifically regulating the fluorine emissions. The regulations differ among the various countries. In Germany and in the Netherlands the regulations pertain solely to the emission of gaseous fluorides, this is, hydrogen fluoride. In Norway and Sweden the regulations pertain to both gaseous and particulate fluorine. The maximum allowable emission in the Netherlands is 0.4 kg gaseous F/t aluminum. In Norway the maximum allowable emissions are 1.0 and 2.6 kg gaseous and particulate F/t Al. Gaseous F is damaging to plants and ruminants. The laws and regulations affect only new industrial plants, with the exception of Germany and the Netherlands where already existing aluminum plants may have to comply with the law if its emissions affect the environment in any way. A short-term (0.002 mg gas F/cu m air) and a long-term (0.005 mg F/cu m) maximum allowable value will be issued for West Germany. In Italy the value of 0.020 mg gaseous and particulate F/cu m may not be exceeded during 24-hour measurements and 0.060 mg gas and particulate F/cu m during 30-minute measurements.

N. GENERAL

14783

Popescu, C.

NEW CONTROL METHODS FOR THE GATHERING AND TREATMENT OF GASES WITH FLUORINE CONTENT FROM ALUMINA ELECTROLYSIS. (Methode noi de control la captarea si tratarea gazelor cu continut de fluor de la electroliza aluminei). Text in Romanian. Rev. Chim. (Bucharest), vol. 20:445-447, July 1969. 2 refs.

By developing new methods of determining the content of NaF, $NaAlO_2$, and Na_2SO_4 in the wash water used for r overing HF, it is possible to reduce by half the time required for checking the recovery process in the aluminum plant laboratory. Detection of NaF is by titration of a solution adjusted to a pH of 2.7 with $Th(NO_3)_4$ in the presence of Alizarine S. The $NaAlO_2$ is titrated with a IN solution of HCl until permanent turbidity is reached, then titrated with bromothymol blue until greenish-yellow. The sulfate is determined by titration with $BaCl_2$ dissolved in acetone or alcohol, in an acetic acid milieu, with Alizarine S as an indicator.

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